ROLE OF EMOTION AND ATTENTION IN VARIATIONS IN SEXUAL DESIRE

Nicole Prause

Submitted to the faculty of the University Graduate School
in partial fulfillment of the requirements
for the degree
Doctor of Philosophy
in the Department of Psychological and Brain Sciences,
Indiana University
August 2007

Accepted by the Graduate Faculty, Indiana University, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Doctoral Committee

William P. Hetrick, Ph.D.

David H. Barlow, Ph.D.

Julia Heiman, Ph.D.

August 18, 2006

ACKNOWLEDGEMENTS

This work was supported by the Social Science Research Council through the Sexuality Dissertation Fellowship, the National Institute of Mental Health through the F-32 training fellowship to the Department of Psychological and Brain Sciences at Indiana University, Bloomington, and The Kinsey Institute for Research in Sex, Gender, and Reproduction through the Student Grant-in-Aid. The Psychopathology and Neuropsychometry Laboratory of William Hetrick, Ph.D. and the Sexual Studies Laboratory of Julia Heiman, Ph.D. contributed substantially to data collection and analysis and provided invaluable feedback in the preparation of manuscripts for publication of these data.

ROLE OF EMOTION AND ATTENTION IN VARIATIONS IN SEXUAL DESIRE

Little is known about why individuals vary in their levels of sexual desire. Information processing models, like Barlow's model of sexual functioning, suggest that individuals with higher sexual desire attend more and respond with more pleasant emotions to sexual cues than individuals with lower levels of sexual desire. In this study, 66 participants (33 female) completed a dot detection task, viewing time measure, and evoked response potential (ERP) measures of attention captured by sexual stimuli, and they completed startle eyeblink modulation, retrahens auriculum modulation, stimulus ratings, and electroencephalography power band measures indexing the valence of emotional response to affective stimuli. Participants with high levels of sexual desire were slower to detect targets in the dot detection task that replaced sexual pictures and in the presence of any sexual stimuli and also evinced higher ERP responses to all emotional stimuli. However, sexual desire groups did not differ in their psychophysiological measures of affective modulation nor in their ratings of sexual stimuli. The results suggest that the amount of attention captured by sexual stimuli is a stronger predictor of a person's sexual desire level than the valence of the emotional responses elicited by such stimuli.

William Hetrick, Ph.D.

David Barlow, Ph.D.

Julia Heiman, Ph.D.

Table of contents

The role of emotion and attention in variations in sexual desire

Sexual desire levels vary vastly amongst individuals, and these differences may cause difficulties in their sexual lives. For example, the strength of a person's sexual desire is thought to influence their likelihood of engaging in sexual behaviors that are risky to their physical health (Canin, Dolcini, & Adler, 1999), are illegal (as with minors, Haake et al., 2003), are coercive (Ariely & Loewenstein, 2006), or contribute to extra-pair coupling (Treas & Gissen, 2000). Low sexual desire has been cited as the most prevalent sexual problem in women with estimates of 7% to 43% affected (Garde & Lunde, 1980; Johnson, Phelps, & Cottler, 2004; Laumann et al., 2005; Segraves & Segraves, 1991; Simons & Carey, 2001; Spector, Carey, & Steinberg, 1996). Although it appears to occur less frequently in men with estimates of 1% to 5% affected (Nathan, 1986), the occurrence of low sexual desire in men is likely underestimated (Stoleru, et al., 2003). Despite its prevalence, low sexual desire is recognized as the most treatment-refractory sexual problem (Beck, 1995; Rosen & Leiblum, 1987), and only one empirically-tested, well controlled psychological treatment is available in French (Trudel, Marchand, Ravart, Aubin, Turgeon, & Fortier, 2001). The disparity between treatment demand and availability encourages the potentially dangerous use of off-label pharmacological treatments (Segraves & Woodard, 2006). Problematically high levels of sexual desire have started to receive empirical attention only recently, and one empirically-informed psychological treatment has been developed recently (Sbraga & O'Donahue, 2004). Despite the prevalence and potential negative consequences of extreme levels of sexual desire, the dearth of research addressing sexual desire disorders stands in sharp contrast to other sexual disorders better represented in both basic and applied research literature (Heiman, 1997; Rosen, 2000).

The views of researchers who are investigating methods for altering sexual desire levels are shaped by discipline-specific perspectives. Taking a biological perspective, the targeted agents of change have included hormone imbalances (Riley & Riley, 2000; van Lunsen & Laan, 1997; Warnock, Bundren, & Morris, 1997), vascular problems (Park, Goldstein, Andry, Siroky, Krane, & Azadzoi, 1997), and medication side effects (e.g., Post, 1994; Margolese & Assalian, 1996). Sociological perspectives have described sexual desire problems as primarily a disagreement between two specific sexual partners (Davies, Katz, & Jackson, 1999), or they question the appropriateness of cultural proscriptions for “appropriate” levels of sexual desire (Irvine, 1993; Tiefer, 2001). Psychological viewpoints have focused on the numbers and types of qualitatively distinct reinforcers of sexual behaviors (e.g., orgasm consistency, increasing partner intimacy, domination of one partner, etc.) as underlying the variability in sexual desire levels (Basson, 2001; Hill & Preston, 1996; Hurlbert, 1993). For instance, partner attractiveness predicts the level of desire for men and women (Haselton & Buss, 2001), but men are thought to apply a higher beta weight to the target’s attractiveness in evaluating their own sexual motivation level (Parental investment theory; Leitenberg & Henning, 1995). While this summary necessarily oversimplifies the perspectives of each discipline, it highlights the potential threat these boundaries pose to understanding and altering sexual desire levels. Information processing models, used heavily within the field of psychology, offer an explanatory framework which is less etiologically-dependent. In this study, we adapted an information processing model of sexual functioning proposed by Barlow (1986) to sexual desire variability, and we tested the hypotheses suggested by the model.

An information processing approach describes how information is perceived, processed, and translated into action (Massaro & Cowan, 1993). The perception stage of the information processing of sexual stimuli may include simply identifying a stimulus as sexual, which has been shown to vary widely. For example, men are more likely to identify a stimulus as sexual than women (Rook & Hammen, 1977), and identification by either gender is dependent on the context in which the stimulus is embedded (Castille & Geer, 1993). Another stage of information processing, translating planned behaviors into action, has been a significant focus of research concerning sexual risk taking. For example, individuals often report the intention to use condoms, but their ability to use the condoms correctly influenced whether or not the intention to use condoms translates into physical health benefits (e.g., Crosby, Sanders, Yarber, & Graham, 2003). Finally, research concerning the processing of sexual information is growing quickly within several different areas of sexuality research. Research that could be described as addressing processing in an information processing approach to sexual response has focused on individual differences in processing (e.g., Janssen, Vorst, Finn, & Bancroft, 2002a), preattentive processing (Janssen, Everaerd, Spiering, & Janssen, 2000; Spiering, Everaerd, & Elzinga, 2002), conditionability (Hoffman, Janssen, & Turner, 2004; Koukanas & Over, 1999), and neural response (Krug, Plihal, Fehm, & Born, 2000; Waismann, Fenwick, Wilson, Hewett, & Lumsden, 2003) to sexual stimuli, as well as how the influence of identifying a stimulus as sexual or romantic influences subsequent processing (e.g., Geer & McGlone, 1990; Geer, Judice, & Jackson, 1994). The Barlow (1986) model of sexual functioning is an information processing model that is particularly strong because it is well-specified, has considerable empirical support, and comprehensively integrates many cognitive and emotional aspects of sexual functioning. Barlow's model was developed primarily using studies of erectile functioning. While essentially a model of the physical indicators of sexual arousal, the model also may contribute to our understanding of the mechanisms involved in the activation and regulation of sexual desire.

In his model of sexual functioning, Barlow (1986; see Figure 1.) predicts that the initial emotional response to, and attention captured by, a sexual cue determines which of two processing loops are engaged. One processing loop leads to functional sexual performance and the other leads to dysfunctional sexual performance. The sexual cue may be broad (e.g., highly responsive sexual partner) or narrow (e.g., picture depicting intercourse), and the cue is thought to engage these processing loops without the necessity of conscious, rational appraisal (Wiegel, Scepkowski, & Barlow, 2006). The processes "loop" in the sense that they are predicted to generate feedback affecting subsequent sexual performance. Specifically, the model suggests that when a sexual cue is encountered, first it is evaluated as positive or negative. Those who evaluated the cue positively are proposed to maintain their attention to it and enter the "functional" processing loop. This further increases autonomic arousal and attention to the sexual stimulus, eventually initiating overt sexual approach behaviors (c.f., Gray, 1987), which includes physiological sexual response. Those who evaluate the sexual cue negatively are proposed to attend more to contextual stimuli that are non-erotic (e.g., body image), or to possible negative consequences of the sexual performance (e.g., fearing a partner's reaction to erectile performance). They also are predicted to experience increased autonomic arousal, but their arousal is thought to heighten their attention to performance-related cues that may result in sexual nonresponse and avoidance behavior. The later aspects of this model, particularly the effects of the direction of attention, have been tested extensively, although mainly in men (Abrahamson, Barlow, & Abrahamson, 1989; Abrahamson, Barlow, Beck, Sakheim, & Kelly, 1985; Bach, Brown, & Barlow, 1999; Barlow, Sakheim, & Beck, 1983; Beck, Barlow, & Sakheim, 1983; Beck, Barlow, Sakheim, & Abrahamson, 1987; Cranston-Cuebas, Barlow, & Athanasiou, 1989; Mitchell, DiBartolo, Brown, & Barlow, 1998; Weisberg, Brown, Wincze, &

Barlow, 2001; Wincze, Venditti, Barlow, & Mavissakalian, 1980; Wolchik, Beggs, Wincze, Sakheim, Barlow, & Sakalian, 1980). The model is consistent with the treatments for low sexual desire problems that focus on decreasing negative feelings about sex to increase sexual desire (e.g., Kaplan, 1979; Masters & Johnson, 1976). A very similar model was subsequently proposed for women and has received limited empirical support (Palace & Gorzolka, 1990; Palace, 1995). Although later occurring components of Barlow's (1986) model have been tested extensively, the postulated effects of early, fast processing to sexual cues in the model have not been systematically tested. Yet, it is exactly these earlier processes that may be crucial to understanding the sexual desire construct. Although it is debated whether sexual desire precedes, co-occurs, or follows physiological sexual arousal, models tend to agree that sexual desire is typically an early component of sexual response.

Two primary conceptual challenges arise in operationalizing and testing this model. It is difficult to operationalize emotion and attention as entirely separate processes. The order of engagement for emotion or attention is unclear, a debate delineated clearly between Zajonc (1980) and Lazarus (1982). Also, emotion and attention likely rely on overlapping neural systems, which are not easily separable empirically (e.g., Carretie, Martin-Loeches, Hinojosa, & Mercado, 2001). Finally, attention may alter emotion just as emotion has been shown to modulate attention (Raymond, Fenske, and Tavassoli, 2003), thus it is not surprising that research concerning the primacy of emotional or attention often reach conflicting conclusions (e.g., affect occurs first Loewenstein, Weber, Hsee, & Welch, 2001; attention occurs first Mackintosh & Mathews, 2003). Currently there is no evidence to suggest that attention and emotion processes function differently for sexual stimuli as compared to nonsexual stimuli.

The current study was not intended to resolve those debates, but affect and attention were assessed separately to the extent possible given the methods currently available. Thus, we assumed that emotion and attention are separable constructs. Also, the Barlow (1986) model holds that attention to sexual stimuli becomes relevant after the emotional response to the sexual cue; it did not argue that direction of attention occurred only after an emotional response. Thus, no assumption regarding the primacy of emotion or attention is made in this study. The following sections describe in detail two of the main elements of Barlow's model, emotion and attention, and how each was measured.

The second challenge in operationalizing and testing this model is that the expected outcomes for two potential response combinations to sexual stimuli have not been specified. The Barlow model addresses neither the possibility of *positive* emotional response followed by *decreased* attention to sexual cues nor of a *negative* emotional response to be followed by *increased* attention to sexual cues. These apparently contrasting situations may appear unlikely to occur; however, other lines of research suggest that such constellations do exist and have had significant implications in other, non-sexual psychological functioning. For example, chronic pain patients have been documented to have negative responses to pain-related stimuli; yet they attend preferentially to them and the bias abates with reductions in pain symptoms (Dehghani, Sharpe, & Nicholas, 2004). Relevant for the other potential constellation, individuals who are obese and reported being particularly likely to eat when sensory cues for desirable foods are presented have been shown to direct their attention away from those positive, desirable food cues when they are presented (Johansson, Ghaderi, Andersson, 2004). This had been interpreted as an attempt to regulate their eating behavior. The circumplex model of emotional experience suggests a space within which such apparently contradictory responses may be integrated theoretically. In the circumplex model, it was proposed that the underlying structure of affective experience can best be characterized as an ordering of affective states on the circumference of a circle crossing the dimensions of arousal (which changes the amount of attention engaged) and valence (pleasant or unpleasant; Larsen & Diener, 1992). This includes a population of less frequently occurring emotions that are not very arousing, but are strongly pleasant (e.g., content, calm) or more frequently occurring emotions that are both unpleasant and arousing (e.g., anger). In this model the stability of the very pleasant but not arousing emotions has been questioned most strongly (Remington, Fabrigar, & Visser, 2000).

Given the possibility that a person may additionally either react positively to a cue yet fail to attend to it, or react negatively to a cue yet attend preferentially to it, then hypotheses must be specified for those outcomes. As sexual functioning already has been suggested to be optimal under conditions of positive affect and high attention to sexual stimuli by the Barlow model (1986), it was predicted that both pleasant responses followed by low attention to sexual stimuli and unpleasant responses followed by high attention to the sexual stimuli would result in dysfunctional sexual performance (lower sexual desire, in this case).

Conventionally, sexual arousal and sexual desire have been conceptualized as distinct constructs (e.g., Warnock, 2002) stemming from research in animals distinguishing motivation from consumption (Beach, 1956), leading some researchers even to critique models that fail to separate the constructs in reflection of clinical practices (Conaglen, 2004). However, several lines of evidence suggest that they overlap both theoretically and experientially (Meuleman & van Lankfeld, 2005). Laboratory studies, for instance, suggest that self-reported sexual arousal and sexual desire consistently correlate strongly (Bozman & Beck, 1991; Slob, Bax, Hop, Rowland, & van der Werff ten Bosch, 1996; Wilson, 1977). Questionnaire studies have documented high correlations between subscales for sexual arousal and sexual desire (e.g., Rosen, Brown, Heiman, Leiblum, Meston, Shabsigh, et al., 2000; Wiegel, Meston, & Rosen, 2005). In addition, authors of a focus group study reported considerable variability in women's definitions of sexual desire and sexual arousal, such that the descriptions women provided for what 'sexual arousal' meant to them tended to be very broad including emotional, behavioral, and (non-genital) physical changes (Graham & Sanders, 2002). Yet the genital response-focused operationalization of sexual arousal employed in some research (e.g., Park et al., 1997) does not always reflect this experiential overlap.

Another way of conceptualizing sexual desire is as the awareness of sexual arousal (Everaerd & Both, 2001), which would explain their close linkage. Defined as an "awareness of sexual arousal," we suggest that sexual desire is the cognitive component of sexual arousal (cf. Lang, 1968). Consequently, trait sexual desire was conceptualized as an individual's sensitivity to sexual stimuli, or their predisposition to respond to sexual stimuli with subjective feelings of sexual arousal (cf. Whalen, 1966 who considered sexual arousability to be one dimension of sexual appetite).

Conceptualizing sexual desire as a person's predisposition to respond to sexual stimuli with subjective feelings of sexual arousal allows the use of two theory-based measures to operationalize the construct. Regarding the first measure, Bancroft and Janssen (2000) proposed a model of sexual response postulating, in part, that sexual arousal depends on the balance between sexual excitation and inhibition, and assumes individuals vary in their propensity for sexual excitation and inhibition. Sexual excitation proneness, as measured by the Sexual Inhibition and Sexual Excitation Scales (SIS/SES, Janssen, Vorst, Finn, & Bancroft, 2002a, 2002b) has been found to be a predictor of a number of behaviors and experiences that are related conceptually to sexual desire, such as the frequency of masturbation, number of lifetime sexual partners, and the degree of sexual desire and arousal that participants report in sexual psychophysiological studies (see Janssen and Bancroft, 2006, for a review). Thus, sexual excitation proneness could provide a framework for both the conceptualization and measurement of trait levels of sexual desire. Regarding the second measure, Spector, Carey, and Steinberg (1996) proposed that the desire to engage in sexual activity with a partner or sexual activity by oneself may differ, and that sexual desire as a construct was primarily cognitive. Dyadic Sexual Desire and Solitary Sexual Desire as measured by the Sexual Desire Inventory also have been found to converge with several theoretically related measures of sexual behavior (King & Allgeier, 2000). Given the theoretical appropriateness of the Sexual Excitation Scale, Dyadic Sexual Desire scale, and Solitary Sexual Desire scale, these scales were used as the primary measures of sexual desire. Two variables expected by the Barlow (1986) model to predict sexual desire levels are emotional responses to, and attention captured by, sexual stimuli. These two dimensions were measured separately to test the hypothesized model.

Emotion: Conceptualization and measurement of early affective responses

Lang and his colleagues (1992) have developed a well-validated and widely used method for assessing affective valence in the laboratory commonly referred to as startle eyeblink modulation (SEM). SEM is based on the idea that a primary manifestation of emotion is a change in “action tendency,” which can be conceptualized as a motivational state responsible for preparing a person to approach or avoid relevant stimuli in the environment (Frijda, 1986; Lang, 1993). Action tendencies are thought to be reflected physiologically by motor priming. This efferent response in combination with semantic stimulus knowledge is thought to synthesize as emotional meaning assigned to the stimulus (Conaglen & Evans, 2006). Everaerd and Both (2001) have suggested that the experience of motor preparation may be felt as sexual desire, particularly as features of the sexual experience could be described as having some features of other emotions (Everaerd, 1988). Motor priming can be measured by assessing startle response magnitude (Lang, 1995). In SEM, a startle response typically is generated by presenting a participant with a sudden, brief, aversive stimulus (e.g., loud noise). The aversive stimulus is presented while participants are viewing photographic images of differing valence (e.g., pleasant, neutral, unpleasant). Larger motoric priming, and resultantly larger eyeblink startle, is thought to result from synergistic response matching of startle probes and aversive stimuli.

An attractive characteristic of the startle paradigm is that it assesses a very early emotional response. This affective modulation occurs as early as .8 seconds after slide onset (Bradley, Cuthbert, & Lang, 1993). Although the earlier the startle probe is delivered the more the affective index appears to be contaminated by attention changes (Vanman, Boehmelt, Dawson, & Schell, 1996), participants appear unable to manipulate even long startle latency affective eyeblink amplitude even when they are strongly motivated to do so by experimental manipulation (Mahaffey, Bryan, Hutchison, 2005; Vanman, Paul, Ito, & Miller, 1997). When assessing sexual response, which is vulnerable to many sources of self-report bias (e.g., Fortenberry, Cech, Zimet, & Orr, 1997; Meston, Heiman, Trapnell, & Paulhus, 1998), immutability is a critical feature.

A number of studies suggest that Startle Eyeblink Modulation (SEM) is highly sensitive to individual differences. Differences in psychopathy (Patrick, 1994), fearfulness (Cook, Davis, Hawk, Spence, & Gautier, 1992), introversion (Blumenthal, 2001), and harm avoidance (Corr et al., 1995) appear to alter startle responses to relevant picture domains. Such individual differences in sensitivity to sexual stimuli, and also states of sexual arousal, have been documented repeatedly using this method (Bradley et al., 2001; Graham, Janssen, & Sanders, 2000; Haerich & Khoury, 1994; Koukanas & Over, 2000; Mahaffey, Bryan, & Hutchison, 2005).

Startle eyeblink methods also have proven advantageous for probing sexual processes. For example, Bradley, Codispoti, Cuthbert, & Lang (2001) reported that same-sex erotica rated as somewhat unpleasant on average still evinced inhibited startle. Although heterosexual orientation was simply presumed in that study, this was interpreted as indicating pleasant affect to those same-sex stimuli. In fact, differences have been documented in the startle modulation to sexual stimuli based on differences of sexual orientation (Bradley, Codispoti, Cuthbert, & Lang, 2001; Mahaffey, Bryan, Hutchison, 2005a[1]), using a measure of erotophilia/erotophobia (Sexual Opinion Survey: Haerich and Khoury, 1994, although see replication failure in Mahaffey, Bryan, and Hutchison, 2005b), and sexual desire (Giagiari, Mahaffey, Craighead, & Hutchison, 2005). Overall, the affective startle measure appeared to be a good candidate for assessing emotional response in the current study.

Only two previous studies have examined the relationship between sexual desire levels and startle eyeblink modulation to sexual stimuli. One suggested that individuals with higher levels of sexual desire exhibited more attenuated startle responses to sexual stimuli as compared to those reporting lower sexual desire levels (Giargiari, Mahaffey, Craighead, & Hutchison, 2005), while the other did not find a relationship between the measures (Prause, Janssen, & Hetrick, 2006). The former study departed in three significant ways from more typical acoustic startle paradigms, including the nature of the sexual stimuli, the stimulus set valence balance, and simultaneous collection of pre-pulse modulated responses. First, the Giargiari et al. (2005) study used photographs from the public domain described as “nudes,” while Prause et al. (2006) used sexual stimuli from standardized sets that varied in their level of detail depicted, including showing vaginal penetration. The intensity of sexual stimuli can change responses, as suggested by the results of the dot detection task in the Prause et al. (2006) study, so these differences in stimulus intensity may have been a factor. Specifically, weaker sexual stimuli may be perceived as being more romantic than sexual, and there is evidence that stimuli perceived as romantic are processed differently from sexual stimuli (Geer & Bellard, 1996). The second difference between the Giargiari et al. (2005) and Prause et al. (2006) was that 67% of the stimuli from the Giargiari et al. (2005) study were sexual and no unpleasant or nonsexual pleasant stimuli were included. Other researchers who chose to exclude unpleasant stimuli (Balaban and Taussig, 1994) were unable to replicate affective modulation amongst other stimuli in their set, which they attributed to lacking the standard emotion-enhancing contrast of the unpleasant stimuli. However, others have documented emotion modulation of the startle eyeblink response when stimuli were presented in groups of the same valence (Bradley, Cuthbert, & Lang, 1996; Smith, Bradley, & Lang, 2005), suggesting that one might still expect modulation in these circumstances. Finally, the study by Giagiari and colleagues (2005) measured prepulse inhibition simultaneous with affective startle modulation. This required the administration of additional non-startle auditory probes immediately preceding some affective startle probes. This easily could have introduced variability in the affective startle through anticipation of the non-startle prepulse, although it is unclear how this may have altered the outcome.

The null results of the latter study by Prause, Janssen, and Hetrick (2006) are consistent with other research. For instance, women's subjective and physiological sexual arousal appears unaffected by positive mood induction (Laan, Everaerd, Van Berlo, Rijs, 1995). In a more direct comparison, when distraction and negative affect were manipulated during a sexual stimulus, the impact of distraction was much greater than that of negative affect in altering subjective and physiological sexual arousal (Elliot & O'Donohue, 1997). Far more frequently, still, emotion and mood changes have been documented to alter subjective and physiological sexual response. Perhaps differences could not be documented because SEM assesses only very early emotional response and later emotional responses are better determinants of sexual desire levels. For example, a woman may initially experience a sexual stimulus as pleasant, but gender role expectations regarding the appeal of visual sexual stimuli (Costa, Braun, & Birbaumer, 2003) could "short circuit" her subjective experience of sexual desire causing her to experience subsequent negative affect. However, measures of emotion in the Prause et al. (2006) study that were subject to more conscious control such as sociosexuality questionnaires and ratings of the emotions evoked by the sexual stimuli also failed to predict sexual desire levels. Furthermore, evidence for a strong genetic component explaining differences in sexual behaviors (Dawood, Kirk, Bailey, Andrews, Martin, 2004), sexual desire direction (e.g., Mustanski, 2003) and sexual desire levels (Lyons, et al., 2004; Zion et al., 2006), suggest that sexual desire level should be expected to exert its influence in a fast, automatic way detectable by early emotional response measures.

Three limitations of the SEM task in the Prause, Janssen, and Hetrick (2006) study influenced the design of the current study. First, SEM methods have been found to successfully differentiate unpleasant from neutral stimuli in many studies, but significant differences between *pleasant* and neutral stimuli are less consistently documented (e.g., Jansen & Frijda, 1994; for review see Skolnick and Davidson, 2002). If SEM indeed is less robust in detecting positive (as compared to negative) affective states, a measure more sensitive to differences between pleasant and neutral stimuli, such as the retrahens auriculum muscle (Benning, Patrick, Lang, 2004; Prause, Ames, Stout, Kieffaber, & Hetrick, 2006), might have been more likely to reveal a relationship between affective responses and sexual desire levels. Thus, in this study, we have added that startle measure to assess this possibility. Second, some have suggested that SEM is sensitive only to specific emotions, questioning the dimensional model of emotion on which SEM is based (e.g., Balaban & Taussig, 1994; Zeelenberg, van Dijk, Manstead, & van der Pligt, 2000). This could mean that sexual stimuli do not vary sufficiently, or not consistently enough, in the emotion(s) indexed by the SEM method. However, several studies have failed to link SEM to specific emotions proposed to underlie affective startle modulation, such as anger (Miller, Patrick, & Levenson, 2002) and disgust (Balaban & Taussig, 1994). Since these findings concerning the importance of specific emotions in affective startle are mixed, participants in this study rated the level of disgust, happiness, sexual arousal, and fearfulness they felt in response to each stimulus in addition to how pleasant and/or arousing they found the stimulus. Finally, more consciously controlled emotional processing might be a stronger predictor of sexual desire levels. In addition to the new ratings data collected, additional questionnaires were added assessing potential differences in emotional experiences amongst those with different levels of sexual desire (e.g., Affect Intensity Measure).

Electroencephalographic recordings offer another potential method for assessing emotional response to sexual stimuli. Additional quantitative analyses of EEG frequency band were conducted to investigate whether various cognitive states indexed by these frequency bands may explain variability in individual sexual desire levels. Specifically, alpha band power has been described as indicating a state of relaxed wakefulness (Klimesch, Schack, & Sauseng, 2005). Individuals with lower sexual desire, thought to experience negative, activating anxiety in response to sexual cues, could be expected to display decreased alpha during sexual stimuli as compared to individuals with higher sexual desire. Power analysis of EEG bands is less clearly within explicitly emotional or attention domains as compared to the other tasks, but may suggest interpretations of other findings within the study and help form future research questions.

Attention: Allocation among competing cues

Along with emotional valence, attention capture by sexual stimuli is requisite for satisfactory sexual functioning in the Barlow (1986) model. Attention has been broadly defined as "a limited-capacity mental resource, which can be allocated to various aspects of a scene to facilitate processing" (Eltiti, Wallace, & Fox, 2005, p. 876). Several types of attention have been distinguished, such as preparatory attention (e.g., LaBerge, Auclair, & Sieroff, 2000) and selective attention (e.g., Musa, Clark, Mansell, & Ehlers, 2003). Individual differences (e.g., in depression; McCabe and Gotlib, 1995) have been shown to influence where attention is directed, and attention biases measured in the laboratory have been shown to reflect real-world behaviors (e.g., racial discrimination in the Implicit Association Task, Greenwald, McGee, & Schwartz, 1998).

The findings of several studies suggest, indeed, that the more attention a person allocates to (facilitating aspects of) sexual stimuli, the more sexually aroused he or she will become (e.g., Beck et al., 1983). One study, for example, suggested that men who attend to both the sexual stimulus and the feelings associated with the stimulus experience greater subjective sexual arousal to the sexual stimulus than those who attend only to the sexual stimulus itself (Dekker & Everaerd, 1989). Others similarly report that as self-reported "absorption" declines with repeated viewing of an erotic video the level of self-reported sexual arousal also declines (Koukounas & McCabe, 1997; Koukounas & McCabe, 2001). Participants in those studies, however, also reported that the stimulus became more aversive with repeated viewings, so it is not clear whether the decreases in arousal were due to attentional or emotional changes.

A number of studies have investigated the *object* of attentional focus, rather than the amount of allocated attention. In sexuality research, the idea of attention is most frequently discussed in the context of Masters and Johnson's (1976) suggestion that self-directed focus, or "spectatoring," was the crux of many sexual problems. Self-focus has been described as a process in which a person "attends to information that originates from within and concerns the self," whereas complementary distraction diverted attention "away from the 'correct' attentional focus" (Sbrocco & Barlow, 1996). Spectatoring was thought to increase anxiety and then adversely affect sexual performance (Masters & Johnson, 1970). As a result, sensate focus therapeutic techniques were developed and are used, in part, to reduce attention to one's sexual performance and genital functioning. Indeed, men with erectile dysfunction seem to focus more on their physiological responses than men without erectile dysfunction (Beck & Barlow, 1986; Heiman & Rowland, 1983). Thus men who experience satisfactory sexual functioning find that their sexual arousal increases when their partner also is aroused sexually (Beck & Barlow, 1986). In contrast, men with erectile problems find that their arousal is impeded when their partner is highly aroused, possibly due to the implied pressure to increase their own sexual arousal. In sum, these studies suggest that in later stages of information processing proposed in this model the locus of attention can affect the sexual outcomes experienced.

Several components of the role of attention in this model remain untested. First, studies to date tended to focus on later attentional processes in the information stream (e.g., participant's attention several minutes into a sexual stimulus presentation). Next, although the *direction* of attention (e.g., to sexual or nonsexual cues) has received empirical attention, the effect of the *amount* of attention allotted to the sexual stimuli is less clear. Finally, studies on the effects of attention on sexual information processing have tended to focus on men. To fill these gaps, the current study addressed early differences in attention, focusing on the amount of attention allocated, in both men and women.

There are many methods available to assess attention, including psychophysiological, behavioral, and self-report indices. One behavioral task, the dot detection task (DD, Navon & Margalit, 1983) offers several strengths. The DD task is an experimental procedure that assesses the allocation of attention amongst competing stimuli. The task typically involves the simultaneous presentation of two words or pictures, one from a class of stimuli of interest (e.g., a spider in research on spider phobia) and another from an emotionally neutral class (e.g., kitchen bowl), which are presented for a brief period (e.g., 500 ms; Mathews & MacLeod, 2002). Immediately after these stimuli disappear, a dot appears where one of the two pictures was located. Attentional bias has been defined as faster detection times when the probe is presented in the location where the test image appeared (e.g., spider; Ehrman, et al., 2002).

The DD task has been shown to be sensitive to individual differences, and it allows for the use of disorder-specific stimuli. For instance, depressed individuals locate the probe equally quickly whether it appears in the area of negative or positive stimuli, whereas nondepressed individuals locate the probe more quickly when it appears in the area of a positive stimulus (McCabe and Gotlib, 1995). This has been interpreted as evidence that depressed individuals lack a normative positive bias rather than being biased towards negativity. The task is sensitive enough to document biased processing in individuals with social phobia (Chen et al., 2002), aggressive biases in violent offenders (Smith & Waterman, 2003), and even within-person changes over time such as processing biases in heavy alcohol drinkers that change over the course of their treatment (Townshend & Duka, 2001) and experimentally induced negative biases (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). In one of only two published studies using the DD task to examine aspects of sexual functioning, Bush (2000) measured target detection time for sexual and aggressive words, as compared to neutral words, in female participants with and without a history of sexual trauma. The author found no differences between the two groups in the detection times for sexual and aggressive words, although both groups were slower to detect the probe when either type of emotional word was present. In sum, task performance (e.g., speeded detection of probes in the area of target stimuli) typically has been interpreted as indicating a hypervigilance for threatening and/or unpleasant stimuli by affected individuals. In the second published study using the dot detection task, Wright and Adams (1999) modified the task asking participants to indicate as quickly as possible where within the picture area the dot was located. They found that participants took longer to locate the dot when their preferred gender was shown, as compared to their nonpreferred gender, and that it took them even longer when the preferred gender was shown nude. Based on a slide recall test showing that participants also remembered preferred gender pictures more accurately, the authors interpreted this to mean that response times could have been longer because participants were more "distracted" by depictions of individuals of their preferred gender. In other words, slowed detection time rather than speeded detection time was used as an indicator of interest. This interpretation, however, conflicts with the prevailing interpretation of DD effects.

The conventional interpretation of differences in DD performance is that target detection time should be speeded when the dot is located under a stimulus of interest; however, this interpretation has proven complicated in two primary ways. First, the task has rarely been used with target stimuli that were pleasant to the participants. In the few studies using stimuli that could be positive to the participants, a reverse effect from that predicted was documented. In one case, heavy smokers were slower than light smokers to locate the dot target when it appeared in the area of a smoking stimulus (Hogarth, Mogg, Bradley, & Dickinson, 2003). Similarly, individuals who are more likely to overeat due to the mere presence of food cues, such as the smell of appetizing food, were slower than those less sensitive to external food cues to identify the target when it appeared in the area of a food stimulus (Johansson, Ghaderi, & Andersson, 2004). Finally, in a third study, anxious participants were faster to locate a dot probe when it appeared in the area of a picture of a happy face as compared to a neutral face; speeded attention towards the angry face had been expected due to hypothesized hypervigilance to social disapproval (Fox, Russo, & Dutton, 2002).

The second issue complicating the interpretation of the DD task is that the cause of the probe detection time differences are unknown. Brosschot, de Ruiter, and Kindt (1999) found that the bias score typically used in DD paradigms was insufficient to distinguish between the processes of one group's attention being facilitated towards a stimulus, or another groups's attention being actively biased away from the other stimulus. In the DD paradigms, speeded detection time may be due to greater response activation, poorer response inhibition, or something else. Another part of the difficulty in deciphering what operations might be affecting detection times is that the time scale of each process in the DD task is unknown (Fox, Russo, & Dutton, 2002). Others have presented evidence that widely-varied (100-1500 ms) stimulus presentation times result in the same bias effects in non-clinical samples (Mogg, Bradley, De Bono, & Painter, 1997), which suggests that the mechanism of bias is a simple, sustained attention bias. Although these two issues cloud understanding of the meaning of changes in detection time and very few studies have used positive stimuli with the dot detection task, there is currently more empirical support for the original interpretation.

In support of the notion that slowed detection may actually indicate attention towards the slowing stimulus, Prause, Janssen, and Hetrick (2006) found that individuals who located the dot more quickly when it appeared in the area of a sexual stimulus, as compared to a neutral stimulus, experienced lower levels of sexual desire. According to the more common interpretation of the dot detection task (MacLeod, Mathews, & Tata, 1986), these longer response times could have been interpreted as evidence that those with lower sexual desire attended more to the sexual stimuli as compared to those with higher sexual desire. Indeed, Conaglen (2004) found that a slowing of response times to sexual words by those with lower sexual desire was due, in part, to the novelty of those stimuli. In the Prause, Janssen, and Hetrick (2006) study participants completed two counterbalanced tasks with visual sexual stimuli, such that task order could be used as a proxy for experience with visual sexual stimuli within session. They reasoned that the sexual stimuli in the dot detection task would be less novel to participants who had already seen a number of sexual stimuli in the SEM task as compared to those who had not yet completed the SEM task. Accordingly, greater habituation to the stimuli might have occurred in higher sexual desire participants due to greater previous exposure resulting in reduced attentional capture. Indeed, those with preexposure to sexual stimuli within the same experimental session appeared to attend *less* to the sexual stimuli in the subsequent Dot Detection task as compared to those who completed the Dot Detection task first. This supports the contention that the novelty of sexual stimuli may be a determinant of attention to sexual stimuli, and sexual desire level may be related simply to levels of previous exposure to erotica. However, experience with visual sexual stimulation external to the experimental setting was not assessed, so this information was collected using a questionnaire in the current study. Task order also may have altered attention to sexual stimuli in the dot detection task because of differences in stimulus intensity between the tasks. Others have documented order effects wherein preexposure to a higher intensity sexual stimulus decreased sexual response to a subsequent, less intense stimulus, whereas viewing the weaker stimulus first did not decrease response to the second higher intensity stimulus (Adams, Haynes, & Brayer, 1985). One could argue that the SEM task, with explicit sexual pictures presented with sufficient time (6 s) to more deeply process the stimuli, may provide a more intense sexual stimulus and dampen responses to the dot detection task. However, other evidence argues against the possible change in motivation carrying over in a second task (Latta & Pattern, 1978). Whether or not the differences observed by Prause et al. (2006) between high and low sexual desire participants, regardless of stimulus order, was due to the effects of individual differences in previous sexual stimulus experience, was directly assessed using a questionnaire.

On the other hand, competing interpretations of the task deserve consideration given that the pleasant valence of the stimuli used in the Prause et al. (2006) study was different from the valence of the stimuli typically used in dot detection research (Fox, Russo, & Dutton, 2002). Orienting attention involves several experimentally separable events, which Posner and Cohen (1984) have described as (1) disengaging from the current stimulus, (2) moving attention to the location of the target, and (3) engaging the target. Fox, Russo, and Dutton (2002) succinctly explain:

> ...in the probe-detection task, because both locations are task-relevant, and presentation times are relatively long (c 500 ms), participants may attend alternately to both locations and then continue to dwell on threat-related stimuli once they have been detected. If this indeed were the case, it would become virtually impossible to distinguish between differences in initial orienting and differences in attentional dwell time using the traditional dot probe task (p. 357).

Two well-replicated orienting phenomena, delayed disengagement and inhibition of return, may explain differences in the initial disengagement and final engagement of attention in the dot detection results. Methods for extricating and testing these effects are discussed.

Disengagement has been described as “a basic mechanism by which we regulate emotional upset” (Landry & Bryson, 2004, p. 1115). Delayed disengagement (Fox, Russo, & Dutton, 2002) may explain the differences between groups in the dot detection task. For instance, high anxiety individuals have been shown to have difficulty disengaging fearful, but not sad or other, emotional stimuli (Georgiou, et al., 2005; Rinck et al., 2003). The Dot Detection task itself has been used to garner evidence that high anxiety individuals have specific problems disengaging fearful stimuli (Koster et al., 2004; Yiend & Mathews, 2001). Disengagement may have been delayed in higher sexual desire participants in the Prause et al. (2006) study due to their greater “absorption” (see Tellegen & Atkinson, 1974) by the sexual stimuli, which may have resulted from several processes. For example, individuals who are more absorbed by sexual stimuli tend to have more appetitive and stronger sexual arousal responses to them (Koukounas & McCabe, 1997)[2]. As mentioned earlier, stronger emotional stimuli are known to slow response times in a variety of reaction time tasks (Rinck, et al., 2003; Tipples & Sharma, 2000). Also, it has been argued that individuals who seek out more sexual experiences than others may have a more complex semantic network for sexual stimuli, which could contribute to their absorption by sexual stimuli through additional cognitive elaboration (Manguno-Mire & Geer, 1998). The delayed disengagement interpretation receives preliminary support from a post-hoc analysis conducted by Prause et al. (2006) that showed longer delays to stronger, or more explicit sexual stimuli than to less explicit sexual stimuli.

The second orienting phenomenon that might help understand the seemingly paradoxical findings of Prause et al. (2006) is inhibition of return (Posner & Cohen, 1984), which refers to the case where an individual is slow to return visual attention (i.e., is inhibited) to an area of visual space that was previously searched (e.g., Mackintosh & Mathews, 2003; Watson & Humphreys, 2000). Inhibition of return may explain the differences between sexual desire groups at the stage of engaging the target stimulus. Inhibition of return is primarily a sensory information-driven process (Sapir, Henick, Dobrusin, & Hochman, 2001), which is automatically activated in environments where attention requires redirection (Jiang, Saxe, & Kanwisher, 2004; Wascher & Tipper, 2004), as is the case in the dot detection task. Participants had sufficient time (500 ms) to scan the initial stimulus and direct their attention to the adjacent stimulus, which could indicate that higher sexual desire participants scanned the sexual stimulus first, and more quickly, than lower sexual desire participants.

These three alternative mechanisms to explain performance in the dot detection task, stimulus novelty, stimulus disengagement, and inhibition of return, generate clear, testable predictions. For instance, disengagement and inhibition of return are separable experimentally (e.g., Landry & Bryson, 2004) and neurophysiologically (Dias & Bruce, 1994), although the task of separating these processes could be difficult because some evidence has suggested that these two processes may be operating differently in different populations depending on the context (e.g., high versus low anxiety participants in Fox, Russo, & Dutton, 2002). Delayed disengagement would be supported in higher recognition of nonsexual stimuli by those who were slower to identify the dot after the presentation of sexual stimuli. In the current study, the inhibition of return explanation was tested by decreasing the stimulus display time to see if this reduced (or reversed) the group differences. The novelty explanation could be addressed by quantifying participants' previous experience with visual sexual stimuli or assessing other better-characterized indicators of novelty, such as the P300 component of the evoked response potential. The present study employed the P300 event-related brain potential for this and the reasons described below.

The P300 has been studied extensively. The P300, a positive peak occurring 300 to 800 milliseconds after the onset of a stimulus, occurs in response to task-relevant stimuli. The amplitude of the P300 peak has been interpreted as indicative of many different processes. Generally, the P300 is believed to reflect cognitive processes engaged in comparing the observed stimulus to a previously established mental model of the stimulus (Donchin et al., 1978). Such a comparison results in the P300 serving as an indicator of the presence of any informative, task-relevant stimulus (Hansenne, 1999). The size of the P300 amplitude decreases as task relevance (Sutton et al., 1967) and motivation decrease (Begleiter et al., 1983) and increases as the stimulus becomes more novel through unpredictability (Donchin et al., 1978) or infrequency (Tueting et al., 1971). The P300 latency is believed to be determined by stimulus evaluation time (Polich and Donchin, 1988) and varies with developmental, normal, and clinical differences in memory function (Polich et al., 1990). Given the greater motivation of individuals with high sexual desire for sexual stimuli, they are predicted to exhibit higher P300 responses to sexual stimuli as compared to those with low sexual desire. P300 latency predictions for groups are less clear, but if higher sexual desire participants have more practice evaluating sexual stimuli than lower sexual desire participants, one might reason that P300 latency for higher sexual desire participants would be earlier due to faster stimulus evaluation.

Finally, the dot detection task of Prause, Janssen, and Hetrick (2006) may have introduced incidental learning. The three evenly-distributed trial types (No sex, Sex not target, and Sex target) translate into the target appearing more often in the area of neutral stimuli. This study introduced a fourth pair type, in which both stimuli are sexual, to rule out the potentially different learning rates or incidence of this contingency by making it equally likely that the target would appear in the area of a sexual or neutral stimulus.

Hypotheses

Our model proposes that the affective reactions to sexual cues discriminate individuals based on their level of sexual desire. To test this hypothesis, several different indices of affective reactions to sexual stimuli were used as predictors of self-reported sexual desire levels. The hypothesized outcomes for those measures are that individuals with higher sexual desire levels would:

1. Exhibit greater inhibition of the orbicularis oculi component of their startle reflex in response to probes presented during sexual stimuli as compared to neutral stimuli than those with lower sexual desire.
2. Exhibit greater facilitation of the retrahens auriculum component of their startle reflex in response to probes presented during sexual stimuli as compared to neutral stimuli than those with lower sexual desire.
3. Rate sexual stimuli as more pleasant than those with lower sexual desire.
4. Exhibit greater alpha band activity during viewing of sexual stimuli as compared to neutral stimuli than those with lower sexual desire.

Our model also proposes that attention paid to sexual cues discriminate individuals based on their level of sexual desire. To test this hypothesis, several different indices of attention to sexual stimuli were used as predictors of self-reported sexual desire levels. The hypothesized outcomes for those measures are that individuals with higher sexual desire levels would:

5. Have longer viewing time during a rating task for sexual stimuli as compared to nonsexual stimuli.
6. Exhibit speeded detection of targets in the area of sexual stimuli as compared to nonsexual stimuli during the dot detection task. If inhibition of return explains the pattern of results, then this difference will be reduced or eliminated with the 250 ms intertrial interval between-subjects factor.
7. Greater P300 magnitude enhancement in response to the onset of sexual stimuli as compared to neutral stimuli than those with lower sexual desire.
8. Exhibit longer latency P300 response to sexual stimuli as compared to neutral stimuli than those with lower sexual desire.

Methods

Participants

Eighty-one individuals were recruited through introductory psychology courses, flyers, and a community newspaper ad. Two participants were excluded from all further analyses due to computer failure (N = 2) and another participant was excluded from all analyses due to prolific blinking preventing recording of the SEM or EEG. Due to the complexity of the single experimental section comprised of many different tasks, participant inclusion in analyses was considered across the tasks. Specifically, twelve participants were either missing data for only a single task including the dot detection task (N = 7), picture ratings (N = 2), or had no usable EEG recordings from any lead (N = 3). In the interest of using a consistent data set in these analyses, only the 66 participants with complete data were analyzed, except where it is noted otherwise. Recruitment ads requested male or female volunteers to view “emotional pictures and answer questions about sexuality” however, one flyer specifically requested individuals “who experience low or absent sexual desire” to attract a more representative continuum of sexual desire levels than the higher desire participants typically attracted to participate.

The final set of 66 participants included 33 (50.0%) women and 61 (92.4%) current students. Most participants identified as White non-hispanic (50, 75.8%) or Black/African American (6, 9.1%), and a substantial minority of the sample (9, 13.6%) reported having had a very negative experience associated with sex. Reports indicated that individuals in the sample were generally sexually experienced, that sex was an important part of their lives, and that few had more than “a little” in terms of sexual problems overall (see Table 3).

Volunteers were excluded if they did not have normal or corrected-to-normal vision. Volunteers received either participation credits towards a course requirement or $8 per hour for participating. Indiana University’s Human Subjects Committee approved this study. Participants gave their informed consent and were free to terminate the experiment at any time.

Materials

Questionnaires.

<u>Sexual Desire Inventory.</u>

(SDI; Spector, Carey, & Steinberg, 1996)

This 14-item, self-administered inventory was designed to measure two aspects of sexual desire. It is comprised of items Likert-scaled 0 to 7 or 0 to 8 scales, for which higher numbers indicate greater sexual desire. The “solitary” sexual desire scale, thought to indicate an individual’s desire for autoerotic sexual activity, is measured by 5 items, and the “dyadic” sexual desire scale, thought to indicate an individual’s desire for sexual activity with a partner, is measured by 9 items. The 14 items are summed to calculate a total score (range of 0-112) with high internal consistency (Cronbach’s α Dyadic scale = .86, Solitary scale = .96; Spector, Carey,

& Steinberg, 1996). The scales converge with other measures of sexual desire and are not affected by level of sexual experience (King & Allgeier, 2000). The two subscales correlate only .35, suggesting they capture different variance and may be thought of as separate constructs (Spector, Carey, & Steinberg, 1996). The Dyadic scale has been used as an index of “trait” sexual desire (Giargiari, Mahaffey, Craighead, & Hutchison, 2002; Houle, Dhingra, Remble, Rokicki, & Penzien, 2006). The SDI scales were used as an indicant of each participant’s level of sexual desire/arousal, which was used to classify individuals into groups with high, moderate, or low sexual desire/arousal.

Several other measures of sexual desire exist. For example, the Hurlbert Index of Sexual Desire (Apt & Hurlbert, 1992) is another popular measure of sexual desire; however, the psychometric data supporting the scale are extremely limited. The Sexual Interest and Desire Inventory, though it appears to be used increasingly in recent research, offers no incremental validity over existing measures (Clayton et al., 2006). The Affective and Motivational Orientation Related to Erotic Arousal questionnaire, while thoughtfully constructed and strong psychometrically, was a considerably longer instrument (62 items) and no data addressing its reliability (Hill & Preston, 1996). The SDI particularly appeared appropriate for this study, because its conceptualization of sexual desire resembled the desired conceptualization for this study through its focus on sexual cognitions and feelings.

Sexual Inhibition and Sexual Excitation Scales.

(SIS/SES; Janssen, Vorst, Finn, & Bancroft, 2002a)

This instrument measures propensity for sexual excitation and sexual inhibition. It is comprised of 45 self-report, four point-scale items that can be scored as three scales: sexual excitation (SES), sexual inhibition due to threat of performance failure (SIS 1, e.g., not being able to maintain an erection in intimate situations with a partner), and sexual inhibition due to threat of performance consequences (SIS 2, e.g., pregnancy). Each scale achieved satisfactory reliability (as shown by 7-week test-retest; SES = .76, SIS 1 = .67, SIS 2 = .74) and internal consistency (α SES = .89, SIS 1 = .81, SIS 2 = .73). These theoretically-grounded scales also have demonstrated adequate convergent, divergent and discriminant validity (Janssen et al., 2002a, 2002b).

Sexual Opinion Survey.

(SOS; Fisher, Byrne, White, & Kelley, 1988; Locke & Gilbert, 1995)

This 21-item questionnaire quantifies individual's disposition to response to sexual cues along a positive (Erotophilia) or negative (Erotophobia) dimension. Internal consistency of the scale is high in males (α = .88) and females (α = .90). This scale has demonstrated discriminant, and convergent, validity. Several of these strengths have been verified in cross-validation studies, including cross-culturally. This questionnaire will serve two purposes in this study. The scale represented a consciously-controlled evaluation of sexual stimuli, which may have moderated the relationship between early emotional reactions to sexual stimuli and sexual desire/arousal.

Affect Intensity Measure.

(AIM; Larsen & Diener, 1987)

Meston (2006) documented that women with sexual dysfunction report more negative and positive emotions compared to women who do not report sexual dysfunction when their attention was self-directed. This suggests that emotional lability or emotional range might mediate the effects of attention to sexual stimuli on sexual desire levels. The AIM is comprised of 40 items designed to measure emotional reactivity and temperamental variability, regardless of hedonic tone. The measure focuses on the strength of the emotional response rather than the frequency with which the emotions are experienced. The scale exhibits high internal consistency (Cronbach's $\alpha = .92$), reasonable split-half correlations of .73 to .82 across samples, and exhibits stability in test-retest correlations of .81 with a 3 month interim (Larsen, Diener, & Emmons, 1986). Its construct validity is supported by its convergence with other measures of sociability, arousability/reactivity, and emotionality and its divergence from general extroversion and sensation seeking measures (Larsen & Diener, 1987).

Female Sexual Function Index.

(FSFI; Rosen, Brown, Heiman, Leiblum, Meston, Shabsigh, et al., 2000)

This 19-item scale, with a total score range of 2 to 36, contains 6 subscales and was initially constructed by exploratory factor analyses of 29 investigator-generated items. Questions inquire about sexual functioning over the last 4 weeks and, although participants are permitted to indicate that they had no sexual experience during that time, the scale score is decreased by sexual inactivity. This is conceptually problematic because lower scores may indicate either more sexual difficulties or less sexual activity in the last month, so this must be monitored.

Psychometrically, the instrument appears generally sound with the exception of weak subscales. The total scale and subscales (sexual desire, subjective sexual arousal, genital lubrication, orgasm, sexual satisfaction, and sexual pain) exhibited acceptable internal consistency (all α => .82) and test-retest reliability at two to four week intervals ($r = .76$ to $r = .86$). Limited convergent validity was suggested by high correlations with the Sexual Desire and Interest Inventory and the Changes In Sexual Function Questionnaire and discriminant validity was supported by the lack of relationship with the Locke-Wallace Marital Adjustment Scale (Clayton et al., 2006). The FSFI also has been shown to differentiate groups of women with and without sexual dysfunction (Wiegel, Meston, & Rosen, 2005) and to evince changes before and after treatment periods (Cayan, Bozlu, Conpolat, & Akbay, 2004). However, the high correlations between the sexual arousal and sexual desire subscales, their failure to differentiate consistently as separate factors through factor analysis (Wiegel, Meston, & Rosen, 2005), the low internal consistency of the desire scale, the failure of the desire scale to differentiate low sexual desire women from women with other sexual problems (Meston, 2003), and the inclusion of other sexual desire and arousal measures in this study precludes the use of those subscales from the FSFI.

International Index of Erectile Function.

(IIEF; Rosen, Riley, Wagner, Osterloh, Kirkpatrick, & Mishra, 1997)

This 15-item scale addresses erectile functioning (or dysfunction) experienced by the respondent in the last four weeks. As with the FSFI, decreased sexual activity may appear to be problematic sexual functioning, so this must be monitored. Items were generated from existing questionnaires and qualitative data and 5 domains emerged from an exploratory factor analysis: erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction. All subscales exhibited high internal consistency (all α => .90) and moderate rest-retest reliability (r = .64 for orgasmic functioning to r = .84 for erectile functioning). Discriminant validity for erectile dysfunction was demonstrated, except for the sexual desire subscale, presumably because patients with low desire were screened out of the sample (Rosen et al., 1997). The questionnaire converged with clinician ratings of sexual functioning and diverged from marital satisfaction and social desirability.

Dyadic Adjustment Scale.

(DAS; Spanier, 1976)

The DAS is a measure of relationship functioning consisting of 32 items divided into four subscales: Dyadic Consensus, Affectional Expressions, Dyadic Satisfaction, and Dyadic Cohesion. The Dyadic Consensus subscale includes 13 items asking partners to rate their level of agreement in potential area of conflict (e.g., finances, religion, sex, etc.) on a six-point Likert scale ranging from 0 (always disagree) to 5 (always agree) and is suitable for married, unmarried, or cohabitating couples. The Affectional Expressions subscale consists of 4 items addressing how often the partners engage in physical expressions of love or sexual desire and whether they disagree about those expressions. The Dyadic Satisfaction subscale consists of 10 items that ask about global satisfaction in different areas of the relationship (e.g., frequency of arguments, feelings about the relationship's future potential). The Dyadic Cohesion subscale has five items asking how often the partners engage in rewarding behaviors together (e.g., working on a project together, laughing together). The overall score adjustment score ranges from 0 to 151.

Couple satisfaction and sexual desire are related (Hurlbert & Apt, 1994), making it important to differentiate sexual desire level differences due solely to couple effects. For instance, the current model may only be relevant for cases of low sexual desire that are not due to high levels of conflict in the sexual relationship. The overall score is correlated strongly with other measures of marital adjustment (e.g., Locke-Wallace Martial Adjustment Scale), while the subscales are internally consistent (Cronbach's α .73 or higher, total scale .96).

Tasks

Startle Eyeblink Modulation (SEM)

Participants viewed 81[3] images arranged in 3 blocks of 27 slides each. These images were balanced amongst pleasant, neutral, and unpleasant categories. Sexual stimuli were embedded within the pleasant category, comprising two-thirds of the pleasant stimuli. Additionally, the sexual stimuli were divided equally into more explicit sexual and less explicit sexual subcategories. Except for the more explicit sexual stimuli, all of these images were taken from the International Affective Picture System (IAPS), which included normative ratings from a similar population (Center for the Study of Emotion and Attention, 1995). The pleasant and unpleasant stimuli from the IAPS were balanced for normative arousal rating. The more explicit sexual images were derived from a stimulus set used by Spiering, Everaerd, and Elzinga (2002). These more explicit sexual stimuli included depictions of penile-vaginal intercourse, oral sex, and open legs displaying genitals, whereas the sexual stimuli from the IAPS tended to suggest, rather than directly depict, sexual activity. All stimuli included people. All of the nonsexual stimuli were screened by three trained raters for any sexual content to eliminate sexual content in the images designated as nonsexual.

Electro-myographic activity in response to the startle stimulus was additionally recorded for the Post Auricular rhetens muscle using 2 additional Ag/AgCl electrodes. They were placed (1) just behind the retrahens auriculum over the post-auricular muscle and (2) posterior to the electrode behind the retrahens auriculum with the forehead still serving as the ground. Epochs of EMG recordings were created from 50 ms before to 300 ms after the startle probe onset. The maximum value within the 20 ms to 90 ms post-stimulus window was recorded as the peak value. Electroencephalograms (EEG) also were recorded during the startle task. The sampling rate was 3,000 Hz for both EMG and EEG measures. The rest of the protocol and analyses are consistent with Prause et al. (2006).

Each picture remained on the screen for 6 s. No motor response was required during the task. The average intertrial interval was 14 s (Range = 12 to 17 s). Each block contained 9 negative, 9 neutral, 3 pleasant-nonsexual, 3 highly-explicit sexual images, and 3 less-explicit sexual images. Startle probes were presented binaurally 3, 4, or 5 seconds after the onset of the photograph. The acoustic startle probes were a 50 ms burst of white noise (peak intensity 110dB SPL) with instantaneous rise and fall times. The startle stimulus was generated in GoldWave Digital Audio Editor (Goldwave, Inc. 2002), transmitted via a Mackie 1202-VLZ analog mixer (Loud Technologies, Inc., Woodinville, WA) with continuous pink noise presented at 46.2 dB SPL (Larson Davis Laboratories Model 1800B Precision Integrating Sound Level Meter, scale A, fast mode), and presented over Eartone Gold 3A 10 ohm (tubephone) Audiometric Insert Earphones (Gordon N. Stowe and Associates Inc., Wheeling, IL). The percentage of non-probed stimuli was eighteen, or 22.22%, of the stimuli. These were randomly selected within blocks such that 6 stimuli were unprobed in each block.

Published recommendations guided the selection of measure parameters (Blumenthal, Cuthbert, Filion, Hackley, Lipp, & Van Boxtel, 2005; Dawson, Schell, Bohmelt, 1999). Neuroscan STIM software (Compumedics, Inc.) was used to present the digitized pictures and collect physiological data continuously throughout the procedure. All electrophysiological signals were sampled at 3,000 Hz, amplified by 5 K using a Sensorium, Inc. EPA-6 bioamplifier, high pass filtered at .10 Hz [12 dB/Octave] and low pass filtered at 300 Hz [eighth order elliptic]. Electro-myographic activity in response to the startle stimulus for the eyeblink was recorded with 3 Ag/AgCl 4 mm electrodes filled with electrode gel placed: (1) just below the left eye; (2) 1 cm outside the corner of the left eye; and (3) on the forehead as a ground. To maintain impedances below 10 kΩ, measurement sites on the skin first were swabbed with isopropyl alcohol, lightly abraded with Nuprep gel, cleaned with water, and then dried prior to electrode placement. Epochs of all EMG recordings were created from 50 ms before to 300 ms after the startle probe onset. The maximum value within the 20 ms to 90 ms post-stimulus window was recorded as the peak value.

Picture Rating

Following the startle task, participants rated the dimensions of valence (pleasant vs. unpleasant) and arousal (degree of general arousal induced by the photos) to ensure that the pictures were experienced as belonging to the category for which they were selected. The valence and arousal dimensions were described in a method consistent with the traditional Self-Assessment Manikin procedures (Bradley & Lang, 1994). Additionally, participants rated each photograph for the level of sexual arousal. The ratings were self-paced and used a scale ranging from one to nine. Each dimension was rated separately for all pictures to help participants differentiate sexual arousal from general arousal. Sexual arousal also was described clearly as being different from general arousal. Since some proposed that affective startle modulation might capture variability only in specific emotions, participants also were asked to rate each photograph for the level of disgust, happiness and fearfulness they felt in response to it. As an additional, covert measure of interest, the time that it took for participants to rate each stimulus was recorded. The longer the stimulus is viewed the more interested the person is assumed to be in that stimulus (Bradley, Cuthbert, & Lang, 1990; Lang, Searles, Lauerman, & Adesso, 1980).

Dot Detection Task

With no explicit guidelines for this highly variable task, the standards used here mimic those most commonly used in the task with images (e.g., Fox, Russo, Dutton, 2002; Yiend & Mathews, 2001). Each trial consisted of the following: (a) a black screen displayed for 500, 750, 1000, or 1500 ms; (b) a fixation cross displayed in the center of the screen for 1000 ms; (c) two pictures in the right and left positions on the screen for 250 ms or 500 ms between subjects factor; and (d) a small white dot centered where one of the photographs had been on the next screen refresh (100 ms; see Figure 2

Figure 2.). Participants were instructed to focus on the cross until the pictures appeared, and to locate the dot as occurring in the left or right area as quickly and accurately as possible. If the dot appeared on the left side of the screen, they pressed the “f” key marked with a red sticker; if the dot appeared on the right side of the screen, they should press the “j” key marked with a blue sticker.

Participants responded to 270 picture pair trials. Three general pair types were presented: two sexual photographs (Both sex; *N* = 90), two neutral photographs (No sex; *N* = 90), or one sexual and one neutral photograph (*N* = 90). The pair type was divided equally into those in which the dot target appeared in the area of the sexual photograph (*N* = 45) or in the area of the neutral photograph. As a result, the number of times that the dot target appeared under a sexual or nonsexual picture was equal. The dot subsequently appeared equally often on each side and for each type of picture in a randomized order. The order in which the picture pairs were presented was randomized within three blocks of the task, with a self-paced break occurring after each block. Stimuli were presented and detection times were recorded using Presentation software (NeuroBehavioral Systems, 2004).

As attention is queried 100 ms following the stimulus presentation as compared to emotion being queried much later in the SEM by the long-delay startle probe, one could argue that the DD task actually assesses attention *prior* to the affective responses assessed by SEM. Assessing affect earlier is not feasible in the SEM paradigm, due to the increasing contamination by attention, rather than emotion, that alters blink magnitude at progressively earlier probe times (Vanman et al., 1996). It is assumed that attention differences would continue to be evident at longer latencies since the study makes no assumptions about the primacy of affect or attention, but this assumption requires future empirical investigation.

Electroencephalograms.

Gold electrodes were used to record electroencephalogram (EEG) at Pz, POz, and Oz sites, with each referenced to the nose. Data were taken from three midline sites only, because (1) there is no reason to expect a particular hemispheric distribution for this experiment, and (2) this avoids multicollinearity among ERP measures in multivariate analyses (O'Donnell et al., 1995). EEG electrodes were used according to accepted standards of measurement, preparation, and application (Davidson, Jackson, & Larson, 2000). Electrooculogram activity was recorded with two bipolar electrodes placed infraorbital and supra-orbital to the middle of the right eye to record vertical eye movement and blinking. All electrode impedances were kept below 10 kΩ. All potentials were sampled at 3,000 Hz[4], amplified by 5 K using a Sensorium, Inc. EPA-6 electrophysiological amplifier, with a high pass filter at .10 Hz [12 dB/Octave] and a low pass filter at 300 Hz [eighth order elliptic].

Quantitative EEG analyses were of two main types. The first, spectral analysis, consists of the collection of multiple short periods of digitized EEG that are then subjected to a fast Fourier transform (FFT) algorithm (Cooley and Tukey, 1965). The FFT algorithms for a given experimental condition are averaged over all trials in that condition and used to determine the total power contained in various frequency bands for each electrode site. The bands included in these analyses were delta (0 to 4 Hz), theta (4 to 7 Hz), alpha (8 to 13 Hz), and beta (14 to 30 Hz). Raw data were down-sampled to 1024 Hz for FFT analyses, which provided a frequency resolution of 1 Hz[5], and the data were epoched in three areas for each of 81 trials. The three epochs included 1000 ms immediately preceeding the image onset (Baseline), image onset to 1000 ms post-stimulus onset (ERP area), and 1000 ms to 3000 ms post-stimulus onset (Sustained processing area). These epochs were visually screened and any segments with evidence of blink, movement or flat-line in the VEOG channel were excluded from further analysis. EEG activity from 3 periods in each trial were digitized and then subjected to FFT with 10% epoch duration hamming window taper at the start and end for each epoch.

The second procedure, evoked response potential (ERP), also uses the computer to collect multiple short periods of digitized EEG that are timed-locked to visual (image onset) or auditory (startle probe) stimuli. These segments are averaged to reduce background electrical noise and to produce wave forms from which amplitude (positive or negative microvolts) and latency (milliseconds after the onset of the stimulus) of specified EEG components are determined. Averaged ERPs for each stimulus category of interest (sexual explicit, sexual less explicit, all sexual, pleasant nonsexual, pleasant and sexual, neutral, and unpleasant) were obtained for each participant.

For ERP analyses, recordings were first epoched for each image onset (200 ms prestimulus to 1000 ms postimulus). All signals (Pz, POz, Oz, and VEOG) were FIR low-pass zero-phase filtered at 30 Hz [12 dB rolloff] and baseline-corrected using the average of the entire 200 ms prestimulus interval. Epochs with EEG channels exceeding ± 100 μV were rejected as artifacts. Ocular artifacts were corrected using a procedure described elsewhere (Semlitch, Anderer, Schuster, & Presslich, 1986)[6]. Data were then visually screened for technical artifacts (e.g., flat line) and those affected epochs were manually rejected. P300 amplitude was derived as the most positive deflection between 250-500 ms after stimulus onset. The elapsed time from image onset at the peak was recorded as the P300 latency. Group differences in amplitude and latencies for each component were examined using separate 2 (Sexual desire group: high, intermediate, low) × 4 (Type: Sexual, pleasant, neutral, unpleasant) repeated measures ANOVAs for each site.

Stimuli

Photographs from the International Affective Picture System (IAPS; Center for the Study of Emotion and Attention, 1995) were used for both the SEM and the Dot Detection tasks. Extensive normative data exist for these images, which allowed them to be categorized as pleasant (e.g., skydiving), neutral (e.g., kitchen object) or unpleasant (e.g., mutilated bodies). Additionally, pleasant photographs were classified as either sexual or nonsexual. The IAPS did not have a sufficient number of sexual pictures for this purpose, so additional sexual images were taken from a study conducted by Spiering, Everaerd, and Elzinga (2002). These latter stimuli tended to be more explicit than the erotic pictures in the IAPS; they included depictions of human penile-vaginal intercourse and oral sex, whereas the IAPS slides show nude male and female models, but depict no genitals. All of the images contained people. To be classified as nonsexual or sexual, 3 research assistants (*N* = 1 male) had to agree that sexual content was not, or was, present.

Design and Procedure

Participants started by providing their informed consent. After reassuring the participants of their confidentiality and anonymity, participants completed the questionnaires on a private computer. Experimenters remained available to answer questions for the participant and encouraged the participant to seek clarification from them. Next, participants completed the Startle Eyeblink Modulation task (including the picture ratings) or the Dot Detection task, depending on the order to which they had been assigned randomly.

Participants completed the Startle Eyeblink Modulation task seated in a comfortable chair in a private booth. Since muscle movement, drowsiness, and other electrical noise sources in the environment may contaminate the simultaneously recorded EEG, the booth was an electrically insulated, acoustically isolated chamber for this task. They were told that they would view a series of images, and that they should attend to the picture the entire time that it was on the screen. Also, they were told that they would occasionally hear a loud noise over the headphones but that they did not need to response to the sound. Directly after completing the SEM task and removing the sensors, participants rated each of the pictures that they had viewed during that task.

Participants were then seated behind the computer in a quiet, private cubicle at a distance of approximately 60 cm from the computer monitor for the dot detection task. They were asked to focus on the cross on the screen until a pair of pictures appeared. They were further instructed that immediately after the offset of the two pictures, a small dot would replace one of the pictures. They were asked to to indicate the location of the dot as having replaced the left or right picture by pressing one of two buttons as quickly and accurately as possible on a QWERTY keyboard: the f key with the left index finger when the probe was presented at the left location and the j key with the right index finger when the probe was presented at the right location. The experimenter monitored the participant's completion of initial ten (No sex) picture pairs to ensure that the participant was keeping his or her hands in similar response positions, sitting facing the center of the screen, and attempting to respond quickly. These trials were not included in the analyses. The experimenter then asked if the participant had any questions and left the participant alone in the room to complete the task.

Data reduction and analysis

To minimize the number of statistical tests, a latent score of questionnaires was used as the primary dependent variable reported in the text. The latent factor was derived from three scales, Dyadic Sexual Desire, Solitary Sexual Desire, and Sexual Excitation, and will be referred to as “Sexual Desire.” The Sexual Desire factor was created by performing a principle components factor analysis on the 3 scales specifying 1 factor extraction. The sexual desire latent variable score was used to classify participants into groups of high, medium, or low sexual desire. The groups were formed based on cut scores to create equal numbers in each group (see Results section). These groups were used as the primary dependent variable to test hypotheses predicting differences between individuals with different levels of sexual desire.

Ratings of the stimuli were first analyzed to check for conformity with previously established norms. A one-way ANOVA was used to ensure that the sexual stimuli had been rated as the most pleasant, followed by pleasant, neutral, and unpleasant. Also, the same procedure was used to check that the sexual, pleasant, and unpleasant stimuli had been rated as more arousing than neutral stimuli. Next, a bias score was created for each ratings comparing the emotional responses to the sexual and neutral stimuli. To determine which emotional response best characterized the differences in individuals with different levels of sexual desire, regression analyses compartmentalizing the effects of each emotional response taking into account the effects of the other emotional responses was used. The bias scores were entered into a linear regression predicting the latent variable Sexual Desire score.

Next, electromyographic signals from the SEM task were high-pass zero-phase filtered at 10 Hz, rectified, baseline-corrected using the 50 ms prestimulus interval, and smoothed with a 9-point window. Outliers were not selectively identified and removed; rather, these data were then square root transformed to minimize the impact of any outliers[7]. Peak amplitudes to individual photographs were measured and analyzed. A bias score was calculated for this task by subtracting the average response amplitude to sexual photographs from the average response amplitude to neutral photographs.

Detection time data from the Dot Detection task were z-scored within each participants then 5% trimmed within each participant (Bush, Hess, & Wolford, 1993). Detection times on incorrect trials were not included in any transformations or analyses. A bias score was calculated for this task by subtracting the detection time when a sexual picture was present and the dot appeared in the area of the neutral picture from the detection time when a sexual picture was present and the dot appeared in the area of the sexual picture. Higher bias scores indicated that participants located the target more quickly when it appeared in the area of the sexual picture. The relationship between the two bias scores and our measures of sexual desire were tested using regression analyses.

Exact p values are reported unless the value was less than .001, which is represented by $p < .001$. Corrections for sphericity (Greenhouse & Geisser, 1959) were applied to all repeated-measures analyses. Partial-eta squared (η^2_p), an effect size measure, indicates the proportion of the sum of squares of the effect explained from both the sum of squares of the effect and the sum of squares of the error variance. As a result, it is not influenced by the number of factors in the analysis, and it is reported as warranted.

Results

Latent factor

The questionnaires included in the latent factor "Sexual Desire" score were highly correlated with the latent factor (SDI: Dyadic, r = .85; SDI: Solitary r = .81; SES r = .85) and the factor explained 70.4% of the variance of these indicators. The latent factor scores were distributed normally (Skewness = .37 (SE = .27); Kurtosis = -.52 (SE = .54)). The sample was divided based on their score on this latent variable into 3 groups for analyses[8]: these groups are referred to as the high (N = 23, Female = 10), medium (N = 22, Female = 12), and low (N = 22, Female = 11) sexual desire groups.

Emotion

Ratings

Participants rated the pictures, on average, in the category to which they had been assigned experimentally (see Table 3). Ratings of the "pleasantness" of the stimuli were significantly different ($F(2,122) = 399.27$, $p < .001$, $\varepsilon = .80$, $\eta_p^2 = .87$), with the images categorized as pleasant rated more pleasant than the images categorized as neutral ($F(1,61) = 118.19$, $p < .001$, $\eta_p^2 = .66$) or unpleasant ($F(1,61) = 565.77$, $p < .001$, $\eta_p^2 = .90$). Also, the stimuli classified as unpleasant were rated as much less pleasant than the neutral images ($F(1,61) = 526.37$, $p < .001$, $\eta_p^2 = .90$). Ratings of the "arousal" of the stimuli were significantly different ($F(2,122) = 63.69$, $p < .001$, $\varepsilon = .74$, $\eta_p^2 = .51$), with the stimuli classified as neutral rated as less arousing than the pleasant ($F(1,61) = 254.16$, $p < .001$, $\eta_p^2 = .81$) and unpleasant ($F(1,61) = 8.27$, $p = .006$, $\eta_p^2 = .12$) images. Also, the stimuli classified as pleasant were rated as more arousing than the unpleasant stimuli ($F(1,61) = 43.38$, $p < .001$, $\eta_p^2 = .41$).

For each dimension rated (Arousing, Happy, Sexually Arousing, Disgust, Fear, and Pleasant) the average response to the neutral images was subtracted from the average response to the sexual images[9]. These were entered together into a linear regression, which explained 0% ($R^2_{Adjusted} = -.01$) of the variance in the latent score for Sexual Desire ($F(6,61) = 6.12$, *ns*). The Durbin Watson statistic (.46) suggested that the residuals may be autocorrelated, which violates an assumption of the linear regression procedure. However, visual inspections of individual correlations[10] and scatterplots (see Figure 3.) did not suggest that the lack of effect was due to non-linear data patterns.

Identical regression analyses used the difference scores for the time elapsed to rate each image on the different dimensions. Similarly, these analyses did not explain any significant variance in the Sexual Desire score ($R^2_{Adjusted}$ = -.08) and the Durbin Watson statistic (.41) was consistent with autocorrelated residuals.

Startle eyeblink modulation

First, a simple one-way repeated-measures ANOVA on Picture Type (Pleasant, Neutral, Unpleasant) was conducted to test for the presence of the expected pattern of SEM (Vrana, Spence, & Lang, 1988). There was a main effect of picture type ($F(2,128) = 66.06$, $p < .001$, $\varepsilon = .99$, $\eta^2_p = .51$) such that the magnitude of eyeblink startle during pleasant images was significantly lower than the magnitude during neutral ($F(1,64) = 107.58$, $p < .001$, $\eta^2_p = .63$) or unpleasant ($F(1,64) = 81.54$, $p < .001$, $\eta^2_p = .56$) images, though no other contrasts were significant.

To test the hypotheses posed in this study, a 4 (Slide Type: Sexual, Nonsexual Pleasant, Neutral, Unpleasant) X 3 (Sexual desire group: Low, Medium, High) ANOVA was performed on the eye-blink data. There was a significant main effect of Slide Type (see Figure 6; $F(3,201) = 11.56$, $p < .05$, $\varepsilon = .89$, $\eta^2_p = .15$)[11], but the interaction of Slide Type and Sexual desire group was not significant ($p = .98$). The main effect of Slide Type was driven by startle responses which were smaller during the sexual stimuli than during the unpleasant stimuli ($F(1,62) = 129.85$, $p < .001$, $\eta^2_p = .68$).

The average startle response to the sexual images was subtracted from the average response to the pleasant nonsexual images[12]. This bias score was entered into a linear regression with the latent factor score for Sexual Desire as the dependent variable, but the SEM bias score was not a significant predictor of Sexual Desire (p = .65; see Figure 3 and Figure 6).

Post-auricular startle modulation

First a simple one-way repeated-measures ANOVA on Picture Type (Pleasant, Neutral, Unpleasant) was conducted to test for the presence of the expected pattern of SEM (Benning et al., 2001; Prause et al., 2006). There was no main effect of picture type (p = .17), although response patterns are suggestive of an effect of arousal (see Figure 5.)[13]. The effect of block was significant ($F(2,130) = 16.07$, $p < .001$, $\varepsilon = .95$, $\eta^2_p = .20$). The amplitude of startle responses primarily decreased from the first to the second ($F(1,65) = 27.17$, $p < .001$, $\eta^2_p = .30$) of three blocks of trials showing habituation.

Although the expected effect of valence was not replicated, a 4 (Slide Type: Sexual, Nonsexual Pleasant, Neutral, Unpleasant) X 3 (Sexual desire group: Low, Medium, High) ANOVA was performed on the post-auricular startle data to test the hypotheses posed in this study. There was a significant main effect of stimulus type (see Figure 7; $F(3,186) = 56.63$, $p < .001$, $\varepsilon = .37$, $\eta^2_p = .48$). Contrasts indicate that the post-auricular startle was larger during the pleasant stimuli as compared to the unpleasant ($F(1,62) = 62.52$, $p < .001$, $\eta^2_p = .50$), neutral ($F(1,62) = 54.20$, $p < .001$, $\eta^2_p = .47$), and sexual stimuli ($F(1,62) = 59.87$, $p < .001$, $\eta^2_p = .49$). Also, startle during the sexual stimuli evoked a larger post-auricular reflex than during the neutral stimuli ($F(1,62) = 4.86$, $p = .03$, $\eta^2_p = .07$). None of the other main or interaction effects were significant.

Electroencephalography band activity

A 4 (Slide Type: Sexual, Nonsexual Pleasant, Neutral, Unpleasant) X 3 (Sexual desire group: Low, Medium, High) ANOVA was performed to determine if higher sexual desire levels might lead to more alpha activity in response to sexual pictures. Individuals with usable leads were selected in the same manner as for ERP analysis (e.g., flatlined channel for first 30 trials), so analyses are conducted separately for each site including all participants with usable data at the site[14].

Delta band (.5-4 Hz)

There were no main or interaction effects of delta band activity.

Theta band (4-7 Hz)

There was a significant interaction of Slide Type and Sexual desire group for theta band activity at both the Pz ($F(6,189) = 3.37$, $p = .005$, $\varepsilon = .92$, $\eta_p^2 = .10$) and POz ($F(6,195) = 2.34$, $p = .038$, $\varepsilon = .93$, $\eta_p^2 = .07$) sites. Four, one-way follow-up ANOVAs with group membership predicting theta band power to each stimulus type separately indicated that only the theta band in response to pleasant stimuli differed by group (see Figure 10; $F(2,65) = 3.20$, $p = .048$, $\eta_p^2 = .09$). Although post-hoc comparisons suggested that the difference was driven primarily by the difference between the medium and high sexual desire group, after Bonferroni corrections none of the comparisons reached statistical significance. At POz contrasts reflected a similar pattern whereby the theta band power changes to the pleasant stimuli only differed between groups ($F(2,66) = 3.46$, $p = .037$, $\eta_p^2 = .10$) and the only significant post-hoc Bonferroni-corrected difference existed between high and medium sexual desire groups ($t(43) = 2.13$, $p = .048$, $d_{pooled} = .6$) with the higher sexual desire group exhibiting more theta power in response to the plesant stimuli. There were no main effects or any effects at Oz.

Alpha band (8-12 Hz)

There were no main or interaction effects of alpha band activity.

Beta band (14-30 Hz)

There was a main effect of Slide Type for beta band activity at Pz (see Figure 10; $F(3,189) = 2.95$, $p = .036$, $\varepsilon = .96$, $\eta^2_p = .05$), POz ($F(3,198) = 3.92$, $p = .010$, $\varepsilon = .97$, $\eta^2_p = .06$), and Oz ($F(6,207) = 7.08$, $p < .001$, $\varepsilon = .98$, $\eta^2_p = .09$) sites. Contrasts indicated that beta activity at Pz was greater during pleasant stimuli as compared to sexual stimuli ($F(1,63) = 9.15$, $p = .004$, $\eta^2_p = .13$) and neutral stimuli ($F(1,63) = 4.18$, $p = .045$, $\eta^2_p = .06$). Also, beta activity at POz was greater during pleasant stimuli as compared to sexual stimuli ($F(1,66) = 11.88$, $p = .001$, $\eta^2_p = .15$), neutral ($F(1,66) = 6.42$, $p = .014$, $\eta^2_p = .09$), and unpleasant stimuli ($F(1,66) = 4.76$, $p = .033$, $\eta^2_p = .07$). Finally, a similar pattern occurred at Oz where beta activity was greater during the pleasant stimuli as compared to the sexual ($F(1,69) = 14.19$, $p < .001$, $\eta^2_p = .17$), neutral ($F(1,69) = 13.21$, $p = .001$, $\eta^2_p = .16$), and unpleasant stimuli ($F(1,69) = 12.42$, $p = .001$, $\eta^2_p = .15$) stimuli.

Attention

Viewing time

For each dimension that was rated (Arousing, Happy, Sexually Arousing, Disgust, Fear, and Pleasant) the average rating time for the sexual images was subtracted from the average ratings time for the neutral images. These were entered into a linear regression, which explained 9% ($R^2_{Adjusted}$) of the variance in the latent score for Sexual desire. The slower participants were to rate how arousing ($\beta_{\text{standardized}} = -.28$, $t(63) = -2.01$, $p < .05$, $r = -.24$) or disgusting ($\beta_{\text{standardized}}$ = -

.36, $t(63) = -2.42$, $p < .05$, $r = -.28$) a sexual image was to them significantly predicted Sexual desire level. Specifically, the longer that an individual took to rate how arousing or disgusting the sexual image was, the lower their Sexual desire score.

Role of previous exposure to visual erotica

A subset of 28 participants (N =17 female) completed a question about their current frequency of internet erotica use and estimated the typical number of hours per week they had spent viewing erotica in the last month[15]. Neither the frequency of use or amount of use was correlated significantly with the SEM bias score, PAR bias score, or DD bias score, so these data were not analyzed further.

The correlation of questionnaire scores and the score on the sexual desire latent factor are presented in Table 2. In particular, the two measures that were suggested to mediate the relationship of sexual desire and other tasks, the Affect Intensity Measure and the Dyadic Adjustment Scale, were not statistically related to Sexual desire level.

Dot detection

To test the hypothesis that higher sexual desire level in related to greater attention towards sexual stimuli, a 4 (Pair Type: Both sexual, Sex Target, No sex, Sex not target) X 3 (Sexual desire group: Low, Medium, High) X 2 (Intertrial interval: 250 ms, 500 ms) ANOVA was performed on the dot detection data. There was a significant main effect of Pair Type (see Figure 8.; $F(3,180) = 16.46$, $p < .001$, $\varepsilon = .74$, $\eta^2_p = .22$). Contrasts indicate that participants were slower to locate the target during Both sex trials as compared to Sex target ($F(1,60) = 17.26$, $p < .001$, $\eta^2_p = .22$) and No sex ($F(1, 60) = 8.17$, $p = .006$, $\eta^2_p = .12$) trials. Also, participants were much slower to locate the target during Sex target trials as compared to No sex ($F(1, 60) = 48.71$, $p < .001$, $\eta^2_p = .49$) and Sex not target ($F(1, 60) = 17.56$, $p < .001$, $\eta^2_p = .23$) trials.

The average detection time to the Sex target trials was subtracted from the average detection time to the Sex not target trials. This bias score was entered into a linear regression predicting the latent score for Sexual Desire. The bias score explained 5% of the variance in the latent score for Sexual Desire ($F(1,69) = 4.28$, $p < .05$, $\beta_{standardized} = -.24$, $t(68) = -2.07$, $p < .05$, $r = -.24$). This indicates that participants with higher Sexual Desire scores were slower to locate the dot target when it appeared in the area of a sexual stimulus as compared to when it appeared in the area of a nonsexual stimulus when a sexual stimulus was paired with it.

Evoked response potentials

A 4 (Slide Type: Sexual, Nonsexual Pleasant, Neutral, Unpleasant) X 3 (Sexual desire group: Low, Medium, High) ANOVA with P300 amplitude and (separately) latency as the dependent measure was performed to determine if differences in attention to sexual stimuli might be reflected in this better established measure of attention than dot detection. One of the Pz ($N = 9$), POz ($N = 8$), or Oz ($N = 5$) leads were unusable (e.g., flatlined channel for first 30 trials) for certain participants, so analyses were conducted separately for each site including all participants with usable data at the site.

Pz

There was a main effect of Slide Type ($F(3,198) = 36.19$, $p < .001$, $\varepsilon = .85$, $\eta^2_p = .35$) and a main effect of sexual desire group (see Figure 11; $F(2,66) = 3.50$, $p = .036$, $\eta^2_p = .10$) for P300 amplitude. Contrasts indicated that the amplitude of the P300 component in response to the onset of visual sexual stimuli was greater than the amplitude to pleasant nonsexual ($F(1,66) = 42.95$, $p < .001$, $\eta^2_p = .39$), neutral ($F(1,66) = 120.84$, $p < .001$, $\eta^2_p = .65$), and unpleasant stimuli($F(1,66) = 71.28$, $p < .001$, $\eta^2_p = .52$). Also, the P300 amplitude was lower for the neutral as compared to the pleasant ($F(1,66) = 4.12$, $p = .047$, $\eta_p^2 = .06$) and unpleasant stimuli ($F(1,66) = 10.70$, $p = .002$, $\eta_p^2 = .14$). With regards to the main effect of sexual desire group, Bonferroni-corrected t-tests indicated that the high sexual desire group exhibited higher P300 amplitude on average as compared to the medium sexual desire group ($t(2) = 5.53$, $p = .046$)[16]. There was no significant interaction of Slide Type and Sexual Desire Group for P300 amplitude.

For P300 latency, there was a main effect of Slide Type ($F(3,198) = 20.33$, $p < .001$, $\varepsilon = .88$, $\eta_p^2 = .24$). Contrasts indicated that the P300 peak latency occurred later for sexual stimuli as compared to pleasant nonsexual ($F(1,66) = 47.03$, $p < .001$, $\eta_p^2 = .42$), neutral ($F(1,66) = 28.19$, $p < .001$, $\eta_p^2 = .30$), and unpleasant ($F(1,66) =20.54$, $p < .001$, $\eta_p^2 = .24$) stimuli. It also occurred later for unpleasant as compared to pleasant nonsexual ($F(1,66) =14.95$, $p < .001$, $\eta_p^2 = .19$) and neutral ($F(1,66) =6.31$, $p = .014$, $\eta_p^2 = .09$) stimuli. No other main or interaction effects were significant.

POz

There was a main effect of Slide Type ($F(3,201) = 20.38$, $p < .001$, $\varepsilon = .84$, $\eta_p^2 = .23$). Contrasts indicated that the amplitude of the P300 component in response to the onset of visual sexual stimuli was greater than the amplitude to pleasant nonsexual ($F(1,67) = 13.24$, $p = .001$, $\eta_p^2 = .17$), neutral ($F(1,67) = 78.12$, $p < .001$, $\eta_p^2 = .54$), and unpleasant stimuli($F(1,67) = 21.19$, $p < .001$, $\eta_p^2 = .24$). Also, the P300 amplitude was lower to the onset of neutral as compared to the pleasant nonsexual ($F(1,67) = 11.03$, $p = .001$, $\eta_p^2 = .14$) and unpleasant ($F(1,67) = 24.05$, $p < .001$, $\eta_p^2 = .26$) stimuli. There were no other main or interaction effects.

For P300 latency, there was a main effect of Slide Type (F(3,201) =18.74, p < .001, ε = .91, η^2_p = .22) consistent with that reported at Pz. Contrasts indicated that the P300 peak in response to sexual stimuli occurred later than the peak in response to pleasant nonsexual (F(1,67) = 41.87, p < .001, η^2_p = .39), neutral (F(1, 67) =21.34, p < .001, η^2_p = .24), and unpleasant (F(1, 67) =18.77, p < .001, η^2_p = .22) stimuli. The peak was also later in unpleasant as compared to pleasant nonsexual (F(1, 67) = 15.77, p < .001, η^2_p = .19) stimuli, and in neutral as compared to pleasant nonsexual (F(1, 67) = 6.45, p = .013, η^2_p = .09) stimuli. No other main or interaction effects were significant.

Oz

There was a main effect of Slide Type (F(3,210) = 6.90, p = .001, ε = .82, η^2_p = .09). Contrasts indicated that the amplitude of the P300 component in response to the onset of visual neutral stimuli was greater than the amplitude to sexual (F(1,70) = 21.32, p < .001, η^2_p = .23), pleasant nonsexual (F(1,70) = 12.79, p = .001, η^2_p = .23), and unpleasant (F(1,70) = 14.63, p< .001, η^2_p = .17) stimuli. There were no other main or interaction effects.

For P300 latency, there was a main effect of Slide Type (F(3,210) =13.79, p < .001, ε = .96, η^2_p = .17) and Sexual Desire group (F(1, 70) = 3.36, p = .040, η^2_p = .09). Contrasts indicated that the P300 peak in response to sexual stimuli occurred later for the sexual as compared to the pleasant nonsexual (F(1, 70) = 24.38, p < .001, η^2_p = .26), neutral (F(1, 70) = 31.64, p < .001, η^2_p = .31), and unpleasant stimuli (F(1, 70) = 10.73, p = .002, η^2_p = .13). It also occurred later for the unpleasant as compared to the pleasant ($F(1, 70) = 6.41$, $p = .014$, $\eta^2_p = .08$) and neutral ($F(1, 70) = 8.00$, $p = .006$, $\eta^2_p = .10$) stimuli.

Despite these statistical conclusions, visual inspection of the grand average ERP in Figure 11 suggested that the high sexual desire group differed not only in their response to sexual stimuli as compared to the other groups, but also differed in their response to emotional stimuli (e.g., sexual, nonsexual pleasant, and unpleasant) as compared to neutral stimuli. Specifically, it appeared that the P300 amplitude for the high sexual desire group in response to any emotional stimuli were higher than to nonemotional, neutral stimuli. As a result, a 2 (Emotion content: has emotional content, has no emotional content) X 3 (Sexual desire group: High, medium, low) was conducted for each site to determine if the interaction term was significant. The interaction pattern was the same for Pz ($F(2,64) = 1.24$, $p = .037$, $\varepsilon = 1.00$, $\eta^2_p = .037$), POz ($F(2,63) = 2.20$, $p = .119$, $\varepsilon = 1.00$, $\eta^2_p = .065$), and Oz ($F(2,67) = 3.68$, $p = .030$, $\varepsilon = 1.00$, $\eta^2_p = .099$). While the pattern was the same, the interaction term was significant only at one site (Oz; see Figure 12), and the high sexual desire participants had a larger difference between the emotional and neutral stimuli than the medium and low sexual desire groups.

Discussion

The purpose of this study was to test an information processing model of sexual functioning in order to better understand the nature of individual variability in levels of sexual desire. Two important processes, consistent with Barlow's (1986) model of sexual dysfunction, were hypothesized to account for such differences. The first process, the capture of attention by sexual stimuli, was evaluated using a dot detection task, viewing time, and P300 magnitude and latency measures; the second process, the valence of emotional responses to sexual stimuli, was assessed using a startle eyeblink modulation, retrahens auriculum startle modulation, ratings, and

EEG band measures. This study confirmed a strong effect of attentional capture by sexual stimuli predicting participants' levels of sexual desire. In contrast, indices of emotional processing did not relate to sexual desire levels, consistent with previous findings (Prause, Janssen, & Hetrick, 2006).

Emotion

The replication of the null findings with regards to emotional responses to sexual stimuli across levels of sexual desire suggests that those responses are, in fact, less predictive of sexual desire levels than differences of attention to sexual stimuli. The expected basic affective modulation of the orbicularis oculi was replicated, but it was not mediated by Sexual desire. Lending credence to the idea that the task itself was appropriately conducted and analyzed, expected habituation effects were unambiguous in the data and longer onset latency startle probes produced clearer affective differentiation of the stimuli (as had been documented previously in Bradley, Cuthbert, & Lang, 1993). The unexpected lower magnitude of the sexual stimuli in the retrahens auriculam startle reflex, however, means that the basic affective modulation was not replicated for that measure. This may be due, in part, to the unusual nature of the pleasant stimuli (e.g., very explicit sexual) in this study. EEG band power analyses did not differentiate Sexual desire groups based on their responses to the sexual stimuli, although higher sexual desire participants did exhibit somewhat more theta power to pleasant stimuli than medium sexual desire participants. As mentioned in the introduction, though, band analyses are not specific to affective variability and should not necessarily be considered as confirmation of the absence of the effects of emotion. Ratings of emotional responses to sexual stimuli also were unexpectedly poor predictors of Sexual desire.

The replication of the lack of SEM effects with sexual desire level supports earlier findings using a similar paradigm (Prause, Janssen, & Hetrick, 2006). The ratings data suggest that this is not simply due to assessing the emotional response too early in processing, because the ratings also did not show any relationship with sexual desire levels. The failure to find a relationship between sexual arousal ratings of the sexual stimuli is surprising and contradicts theories concerning sexual arousability (cf. Whalen, 1966) as well as the study of Prause et al. (2006), which documented a moderate ($r = .43$) relationship between ratings of stimuli for sexual arousal and the individual’s Sexual desire level. The participants in the previous study (Prause et al., 2006) were skewed towards higher levels of sexual desire. It is possible that a person’s sexual desire must be higher than a certain threshold before they make finer distinction amongst more sexually arousing stimuli; while this seems unlikely, such an effect would mean that the previous sample produced greater variability in their ratings of the stimuli than participants in the current study.

Frequency bands demonstrated a mixed relationship with Sexual desire groups that proved difficult to decipher. First, the projected differences in alpha band power did not manifest. Second, there was an interaction of band power and stimulus type for theta band activity. Finally, there was a main effect of stimulus type on beta band activity. The differences at Pz and POz suggested that medium level sexual desire participants experienced much less theta band power to pleasant stimuli. Some have suggested that theta might be more reflective of short term memory processes including encoding and retention, whearas alpha has been shown to diverge during long term memory function specific to information retrieval (Klimesch, Schack, & Sauseng, 2005). Thus, incorporating the apparent disparity with the alpha band power differences, one (highly speculative) way of interpreting these results is that low and high sexual desire participants were engaging more working memory processes. This non-specific processing difference, however, could reflect entirely divergent goals states such as diverting attention away from aversive sexual stimuli in the low sexual desire participants or generating complex sexual fantasy that includes recalling memories from a more extensive sexual history in the high sexual desire participants.

The beta band differences were also due to effects of the pleasant stimuli, which generally evoked greater beta band power than the other stimuli at each site. Generally, enhancement of beta band activity is viewed as inversely related to alpha band power. This phenomenon is known as alpha blocking, and it has lead some to suggest that beta band power is actually a more sensitive measure of cognitive engagement (Papanicolaou, Loring, Deutsch, & Eisenberg, 1986). Increased beta band power has been linked to increased anxiety and reduced relaxation (Jacobs, Benson, Friedman, 1996), and P50 sensory gating (Hong, Summerfelt, McMahon, Thaker, & Buchanon, 2004). In the context of these data, it seems unlikely that pleasant stimuli should uniquely engage anxious processes, or that pleasant stimuli would be more absorbing than the unpleasant or sexual stimuli. Unless additional evidence suggests that suppression of attention to the sexual or unpleasant stimuli may cause the pleasant stimuli to appear to garner more attention in contrast, these findings may prove difficult to replicate. Given the strong suggestion in many therapeutic approaches that modification of affective responses to sexual stimuli is compulsory to alter sexual desire, the absence of the effects of any emotional assessment requires further investigation and reconciliation.

These findings also provide additional information concerning the effect commonly referred to as Sexual Content Induced Delay (SCID). Geer and McGlone (1990) first noted this specific tendency for a variety of laboratory responses to be slowed in the presence of sexual stimuli, although delayed responses to sexual stimuli have certainly been noted previously in other contexts (e.g., Bradley, Cuthbert, & Lang, 1996). Alternatively, this delay has been explained as a result of general slowing due to the presence of any emotional stimuli (Spiering Everaerd & Elzinga, 2002), to specific emotions evoked by sexual stimuli (Geer, Judice, & Jackson, 1994), and to stimulus novelty of erotica in participant subgroups (low sexual desire women in Conaglen & Evans, 2006). The present study replicated the SCID, and suggests further that the delay is not likely due to accelerated processing of nonsexual stimuli in subgroups, which would have been suggested if inhibition of return were supported in the dot detection task.

Attention

With respect to attention, the major findings included that (1) the results of the dot detection task that individuals with higher levels of sexual desire are slower to locate targets in the area of sexual stimuli could not be explained by inhibition of return, stimulus novelty, or incidental learning, and (2) ERP analyses point to a heightened P300 response to any emotional stimuli in those reporting higher sexual desire. The stimulus display time factor (250 ms cp. 500 ms) in the dot detection task did not cause higher desire participants to identify the target in the area of the sexual stimulus more quickly, which would have been expected if inhibition of return explained the pattern of results. The participants also did not vary in the Dot detection bias score based on their previous level of experience with visual erotica, which suggests that novelty is not an adequate explanation either.

Lower sexual desire participants might have attended to the sexual stimuli more because they were attending to different, possibly negative, emotional aspects of the stimulus (Dove & Wiederman, 2000), while higher sexual desire participants were engrossed by the enjoyable, positive aspects of those stimuli. However, the lack of group effects in several measures of emotional response argues against this interpretation. Another possibility is that individuals with higher sexual desire may have experienced a stronger emotional reaction to the sexual stimuli than the lower sexual desire group, and emotional stimuli (nonsexual as well) are known to slow response times (Rinck, et al., 2003; Tipples & Sharma, 2000). That is, participants with higher levels of sexual desire may have experienced stronger positive emotions, including sexual arousal, to the sexual pictures. Longer delays in detecting the stimulus, then, may have been caused by more valence-related attentional engagement, or absorption (see Tellegen & Atkinson, 1974), in participants with high sexual desire.

An entirely different, unexpected strategy to regulate sexual arousal or other emotions also could have driven differences between the groups in the dot detection task, although this seems less plausible. In the case of eating, it has been observed that individuals who are dieting will actively decrease monitoring of food cues, including eating restraint cues (Gemma & Brunstom, 2005), though the pleasure associated with those cues may have contributed to the initiation of the diet. Individuals with high sexual desire may have actively directed their attention away from sexual stimuli. For instance, in a university sample the belief that being sexually aroused for long periods of time without reaching orgasm results in increasing physical discomfort and intense pain is commonly endorsed (DeGue & DiLillo, 2005). Similarly, high levels of sexual desire and sexual arousal are thought to distort judgment (Canin, Dolcini, & Adler, 1999). Thus, participants with higher sexual desire in this study may have strategically avoided sexual stimuli to avoid perceived consequences of becoming aroused in the laboratory setting. This possibility could be assessed in the future by monitoring subjective feelings of sexual desire and arousal during the tasks.

The lack of consistent group differences in evoked response brain potential measure (e.g., P300) could be due to the measure occurring too early to detect attention differences to the stimuli that interact with sexual desire level. Those differences may emerge only in subsequent processing. For example, while no individual differences were apparent in affective responses to sexual stimuli during the peak startle magnitude in a 20-90 ms window subsequent to the stimulus onset, there was a clear tendency for participants with higher sexual desire to rate sexual stimuli as more pleasant. However, the possibility that ERP differences based on sexual desire level did not emerge because the P300 is too early to detect group differences is contradicted by data in this and other research. The complexity of electrocortical responses beyond 300 ms have been described as "much greater than has previously been assumed" (Anokhin et al., 2006, in press). This was concluded, in part, in light of evidence that frontal cortices can be activated in categorization processes within 30 ms (Fixe & Simpson, 2002). Thus, a 300 ms window is ample time for neural transmission and inhibition modulated by individual differences in the processing of emotional stimuli to intercede (e.g., Justus, Finn, & Steinmetz, 2001), and gender differences in the ERP to sexual stimuli have been documented to occur as early as 160 ms post-stimulus onset (Anokhin et al., 2006). Furthermore, attention differences due to sexual desire level were very clear in the Dot Detection task, even when the stimulus presentation time was only 250 ms.

Examination of the ERP figures pointed to the alternative interpretation that sexual desire appeared to explain differences in response to emotional versus neutral stimuli, rather than to sexual stimuli specifically. Specifically, there are visible differences in the ERPs by sexual desire group (see Figure 11) whereby those with high sexual desire exhibit higher magnitude P300 in response to sexual stimuli. Subsequent post-hoc analyses collapsing across emotional and non-emotional stimuli supported this interpretation. The fact that these differences could not be documented in the initial analyses may be due to a low signal to noise ratio. The signal to noise ratio could have been increased appreciably by the addition of more trials in each stimulus category. In this study, each major category (pleasant, neutral, unpleasant) was represented by only 27 trials, and the sexual stimuli comprised only 18 total trials. With the simultaneously recorded startle probe possibly increasing the base rate of blinks, trials available for inclusion were further decreased. Although some have reported similarly low numbers of trials used to construct ERP averages (e.g., 20 per category in Morita, Morita, Yamamoto, Waseda, Maeda, 2001), averages based on 100 or more trials are common (for review see Picton et al., 2000). Future research should further investigate these results by increasing the number of trials per category and recording EEG without the simultaneous presentation of startle probes.

Signal impedances also may have contributed to increased noise. For instance, some recommend maintaining impedance below 5K (e.g., Gray, Ambady, Lowenthal, & Deldin, 2004) or even 3K (Glabus, et al., 1994), whereas impedances for EEG in this study were only maintained below 10K. However, these other explanations are far less likely as impedance levels are less significant with more modern equipment (e.g., Davidson, Jackson, & Larsen, 2000), and the abrasion required to lower impedance levels may have undesirable side effects such as inducing negative affect.

On the other hand, the fact that differences could not be documented statistically between these four groups of stimuli (sexual, pleasant nonsexual, neutral, and unpleasant), yet were documented between emotional versus emotionally-neutral stimuli more broadly, could indicate more global emotion processing differences. Time series modeling of cyclic emotion regulation strategies have documented high variability between individuals in their characteristic experiences of the intensity of emotions across time, how quickly the asymptotic experience is approached, and the rate of change in emotional experience (Chow, Ram, Boker, Fujita, Clore, 2005). These differences have been quantified in a variety of theoretical approaches including Highly Sensitive Person (Benham, 2006) and Emotional Intensity (Larsen, Diener, & Emmons,

1986) measures, and poor affective regulation is implicated in a variety of mood, affect, and personality disorders. However, sexual desire levels were not related to the Affect Intensity Measure in this sample, ratings of any emotional response to any stimulus class, nor even physiological emotion modulation indices. The striking absence of effects despite the pattern in the P300 amplitude suggests that the finding requires replication and alternative measures of broad affective differences may be appropriate.

Conclusion

Taken together, these results have important implications for research concerning sexual stimulus processing if the effects of attention account for any effects of affective response. As illustration, few studies separately and simultaneously assess the effects of attention and affect on sexual response, leaving the possibility that differences in attention may explain many of the effects that researchers attributed to affect. In one study, women were asked to adopt negative or positive sexual schemas prior to visual sexual stimulation, and negative schemas generally resulted in less subjective and physiological sexual arousal (Kuffel & Heiman, 2006). While it was suggested that distraction due to difficulty adopting negative schemas could explain mood differences, distraction and other attention factors were not directly assessed. Given that the strength of the manipulations' effect on general arousal could affect the direction of attention, this alternate interpretive lens suggests that negative schemas may have absorbed more attention that had been allotted to the sexual stimuli increasing sexual arousal in the positive schema adoption.

Early evidence supporting this primacy of attention in the information processing of sexual stimuli is also emerging in new research that considers these elements simultaneously. Conaglen and Evans (2006) attempted to assess both emotional feelings about sexual stimuli and attention paid to them in people that varied in their level of sexual desire. While they found in the women small differences of more negative affect to sexual stimuli by the lower sexual desire women, lack of reported interest in sexual stimuli much more clearly predicted sexual desire levels. Clearly the series of studies by Barlow and colleagues examining the effects of attention on sexual arousal raised many of these questions years ago, and new research in this area directly comparing affect and attention may help clarify some of the seemingly conflicting results from those studies.

The Barlow (1986) model has been revised to include a clearer bio-psycho-social perspective (Wiegel, Skepkowski, & Barlow, 2006). While the model changes and additions are grounded in empirical work and clinical theory, which acknowledges the tremendous complexity in understanding sexual functioning, this study testing the earlier more parsimonious and tractable version of the model suggests the strengths of the simpler approach. This study partially supports the Barlow (1986) model as applied to sexual desire. Specifically, these data suggest that attention to sexual stimuli may prove a strong target for changing sexual desire levels therapeutically, whereas the potential clinical utility of the new complex model will require additional research.

Given the information processing differences documented during state sexual arousal (Ariely & Loewenstein, 2006), controlling state levels of sexual arousal may offer greater insight into group differences in trait levels sexual desire. For instance, information processing differences between individuals with high and low anxiety were not apparent in one task except in interaction with their current level of anxiety (Fox, Russo, Dutton, 2002). This is parallel to research showing men with and without erectile dysfunction tend not to differ in baseline reports of sexual arousal or attitudes, but a variety of cognitive differences become apparent when stimuli provoke sexual arousal (e.g., Beck & Barlow, 1986). An extension of this study could include induction of sexual arousal balanced by baseline measures to the same tasks.

In conclusion, the current study suggests that individual differences in the processing of sexual stimuli account for a significant portion of the variance in sexual desire levels. Specifically, attentional capture by sexual stimuli predicted differences in levels of sexual desire. The present studies demonstrate that Barlow's model of sexual functioning, particularly its characterization of information processing mechanisms, can serve as a useful benchmark for theoretical progress in this field. Following a benchmarking strategy (Wade, Treat, & Stuart, 1998), the model could lead to the development of therapeutic methods for altering problematic levels of sexual desire.

Works Cited

Abrahamson, D. J., Barlow, D. H., & Abrahamson, L. S. (1989). Differential effects of performance demand and distraction on sexually functional and dysfunctional males. *Journal of Abnormal Psychology, 98*(3), 241-247.

Abrahamson, D. J., Barlow, D. H., Beck, J. G., Sakheim, D. K., & Kelly, J. P. (1985). The effects of attentional focus and partner responsiveness on sexual responding: Replication and extension. *Archives of Sexual Behavior, 14*(4), 361-371.

Adams, A. E., Haynes, S. N., & Brayer, M. A. (1985). Cognitive distraction in female sexual arousal. *Psychophysiology, 22*(6), 689-696.

Ames, K., Prause, N., Stout, K., & Hetrick, W. P. (2003). Differential effects of affective modulation on orbicularis and post-auricular indices of startle. *Psychophysiology, 40*(Supp 1), S22.

Anokhin, A. P., Golosheykin, S., Sirevaag, E., Kristjansson, S., Rohrbaugh, J. W., & Heath, A. C. (2006). Rapid discrimination of visual scene content in the human brain. *Brain Research, In Press*.

Apt, C., & Hurlbert, D. (1992). Motherhood and female sexuality beyond one year postpartum: A study of military wives. *Journal of Sex Education and Therapy, 18*(2), 104-114.

Ariely, D., & Loewenstein, G. (2006). The heat of the moment: the effect of sexual arousal on sexual decision making. *Journal of Behavioral Decision Making, 19*(2), 87-98.

Ariely, D., & Loewenstein, G. (2006). The heat of the moment: the effect of sexual arousal on sexual decision making. *Journal of Behavioral Decision Making, 19*(2), 87-98.

Bach, A. K., Brown, T. A., & Barlow, D. H. (1999). The effects of false negative feedback on efficacy expectancies and sexual arousal in sexually functional males. *Behavior Therapy,* *30*, 79-95.

Balaban, M. T., & Taussig, H. N. (1994). Salience of fear/threat in the affective modulation of the human startle blink. *Biological Psychology, 38*(2-3), 117-131.

Bancroft, J., & Janssen, E. (2000). The dual control model of male sexual response: a theoretical approach to centrally mediated erectile dysfunction. *Neuroscience & Biobehavioral Reviews, 24*(5), 571-579.

Barlow, D. H. (1986). Causes of sexual dysfunction: The role of anxiety and cognitive interference. *Journal of Consulting & Clinical Psychology, 54*(2), 140-148.

Barlow, D. H., Sakheim, D. K., & Beck, J. G. (1983). Anxiety increases sexual arousal. *Journal of Abnormal Psychology, 92*(1), 49-54.

Basson, R. (2001). Using a different model for female sexual response to address women's problematic low sexual desire. *Journal of Sex & Marital Therapy, 27*(5), 395-403.

Beach, F. A. (1956). *Characteristics of masculine "sex drive".* Paper presented at the Nebraska symposium on motivation, University of Nebraska.

Beck, J. G. (1995). Hypoactive sexual desire disorder: An overview. *Journal of Consulting & Clinical Psychology, 63*(6), 919-927.

Beck, J. G., & Barlow, D. H. (1986). The effects of anxiety and attentional focus on sexual responding: I. Physiological patterns in erectile dysfunction. *Behaviour Research & Therapy, 24*(1), 9-17.

Beck, J. G., Barlow, D. H., & Sakheim, D. K. (1983). The effects of attentional focus and partner arousal on sexual responding in functional and dysfunctional men. *Behaviour Research & Therapy, 21*(1), 1-8.

Beck, J. G., Barlow, D. H., Sakheim, D. K., & Abrahamson, D. J. (1987). Shock threat and sexual arousal: The role of selective attention, thought content, and affective states. *Psychophysiology, 24*(2), 165-172.

Benham, G. (2006). The Highly Sensitive Person: Stress and physical symptom reports. *Personality and Individual Differences, 40*(7), 1433-1440.

Benning, S. D., Patrick, C. J., & Lang, A. R. (2004). Emotional modulation of the post-auricular reflex. *Psychophysiology, 41*(3), 426-432.

Blumenfeld, L. D., & Clementz, B. A. (2001). Response to the first stimulus determines reduced auditory evoked response suppression in schizophrenia: Single trials analysis using MEG. *Clinical Neurophysiology, 112*(9), 1650-1659.

Blumenthal, T. D. (2001). Extraversion, attention, and startle response reactivity. *Personality & Individual Differences, 31*(4), 495-503.

Blumenthal, T. D., Cuthbert, B. N., Filion, D. L., Hackley, S., Lipp, O. V., & Van Boxtel, A. (2005). Committee report: Guidelines for human startle eyeblink electromyographic studies. *Psychophysiology, 42*(1), 1-15.

Bozman, A. W., & Beck, J. G. (1991). Covariation of sexual desire and sexual arousal: The effects of anger and anxiety. *Archives of Sexual Behavior, 20*(1), 47-60.

Bradley, M. M., Codispoti, M., Cuthbert, B. N., & Lang, P. J. (2001). Emotion and motivation I: Defensive and appetitive reactions in picture processing. *Emotion, 1*(3), 276-298.

Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (1990). Startle reflex modification: Emotion or attention? *Psychophysiology, 27*(5), 513-522.

Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (1993). Pictures as prepulse: Attention and emotion in startle modification. *Psychophysiology, 30*(5), 541-545.

Bradley, M. M., Cuthbert, B. N., & Lang, P. J. (1996). Picture media and emotion: Effects of a sustained affective content. *Psychophysiology, 33*(6), 662-670.

Bradley, M. M., & Lang, P. J. (1994). Measuring emotion: The Self-Assessment Manikin and the semantic differential. *Journal of Behavior Therapy & Experimental Psychiatry, 25*(1), 49-59.

Brosschot, J. F., Ruiter, C. d., & Kindt, M. (1999). Processing bias in anxious subjects and repressors measured by emotional Stroop interference and attentional allocation. *Personality and Individual Differences, 26*(5), 777-793.

Bush, L. K., Hess, U., & Wolford, G. (1993). Transformations for within-subject designs: A Monte Carlo investigation. *Psychological Bulletin, 113*(3), 566-579.

Bush, S. I. (2000). Selective processing of sexual, violent, and neutral information: A study comparing individuals with and without a history of sexual trauma. *Dissertation Abstracts International: Section B: The Sciences & Engineering, 60*(9-B), 4878.

Canin, L., Dolcini, M. M., & Adler, N. E. (1999). Barriers to and facilitators of HIV-STD behavior change: Intrapersonal and relationship-based factors. *Review of General Psychology, 3*(4), 338-371.

Carretie, L., Martin-Loeches, M., Hinojosa, J. A., & Mercado, F. (2001). Emotion and attention interaction studied through event-related potentials. *Journal of Cognitive Neuroscience, 13*(8), 1109-1128.

Castille, C. O., & Geer, J. H. (1993). Ambiguous stimuli: Sex is in the eye of the beholder. *Archives of Sexual Behavior*, *22*(2), 131-143.

Cayan, S., Bozlu, M., Canpolat, B., & Akbay, E. (2004). The assessment of sexual functions in women with male partners complaining of erectile dysfunction: Does treatment of male sexual dysfunction improve female partner's sexual functions? *Journal of Sex & Marital*

Therapy, 30(5), 333-341.

Chen, Y. P., Ehlers, A., Clark, D. M., & Mansell, W. (2002). Patients with generalized social phobia direct their attention away from faces. *Behaviour Research & Therapy, 40*(6), 677-687.

Chow, S.-M., Ram, N., Boker, S. M., Fujita, F., & Clore, G. (2005). Emotion as a Thermostat: Representing Emotion Regulation Using a Damped Oscillator Model. *Emotion, 5*(2), 208-225.

Clayton, A. H., Segraves, R. T., Leiblum, S., Basson, R., Pyke, R., Cotton, D., et al. (2006). Reliability and Validity of the Sexual Interest and Desire Inventory--Female (SIDI-F), a Scale Designed to Measure Severity of Female Hypoactive Sexual Desire Disorder. *Journal of Sex & Marital Therapy, 32*(2), 115-135.

Clayton, A. H., Segraves, R. T., Leiblum, S., Basson, R., Pyke, R., Cotton, D., et al. (2006). Reliability and Validity of the Sexual Interest and Desire Inventory--Female (SIDI-F), a Scale Designed to Measure Severity of Female Hypoactive Sexual Desire Disorder. *Journal of Sex & Marital Therapy, 32*(2), 115-135.

Conaglen, H. (2004). Sexual Content Induced Delay: A Reexamination Investigating Relation to Sexual Desire. *Archives of Sexual Behavior, 33*(4), 359-367.

Conaglen, H., & Evans, I. (2006). Pictorial Cues and Sexual Desire: An Experimental Approach. *Archives of Sexual Behavior, 35*(2), 197-212.

Cook, E. W., Davis, T. L., Hawk, L. W., Spence, E. L., & Gautier, C. H. (1992). Fearfulness and startle potentiation during aversive visual stimuli. *Psychophysiology, 29*(6), 633-645.

Cooley, J. W., & Tukey, J. W. (1965). An Algorithm for the Machine Calculation of Complex Fourier Series. *Mathematics of Computation, 19*, 297-301.

Corr, P. J., Wilson, G. D., Fotiadou, M., Kumari, V., Gray, N. S., Checkley, S., et al. (1995). Personality and affective modulation of the startle reflex. *Personality & Individual Differences, 19*(4), 543-553.

Costa, M., Braun, C., & Birbaumer, N. (2003). Gender differences in response to pictures of nudes: A magnetoencephalographic study. *Biological Psychology, 63*(2), 129-147.

Cranston-Cuebas, M. A., Barlow, D. H., & Athanasiou, R. (1989). *The misattribution of male sexual arousal.* Paper presented at the Association for the Advancement of Behavior Therapy, New York.

Crosby, R., Sanders, S., Yarber, W. L., & Graham, C. A. (2003). Condom-Use Errors and Problems: A Neglected Aspect of Studies Assessing Condom Effectiveness. *American Journal of Preventive Medicine, 24*(4), 367-370.

Davidson, E., Jackson, D., & Larson, C. (2000). Human Electroencephalography. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Handbook of psychophysiology (2nd ed.)* (pp. 900-923). New York, NY: Cambridge University Press.

Davies, S., Katz, J., & Jackson, J. L. (1999). Sexual desire discrepancies: Effects on sexual and relationship satisfaction in heterosexual dating couples. *Archives of Sexual Behavior, 28*(6), 553-567.

Dawood, K., Kirk, K. M., Bailey, J. M., Andrews, P. W., & Martin, N. G. (2004). Genetic and Environmental Influences on the Frequency of Orgasm in Women. *Twin Research and Human Genetics*.

Dawson, M. E., Schell, A. M., & Bohmelt, A. H. (1999). *Startle modification: implications for neuroscience, cognitive science, and clinical science*. Cambridge: Cambridge University Press.

DeGue, S., & DiLillo, D. (2005). "You would if you loved me": Toward an improved conceptual and etiological understanding of nonphysical male sexual coercion. *Aggression and Violent Behavior, 10*(4), 513-532.

Dehghani, M., Sharpe, L., & Nicholas, M. K. (2004). Modification of attentional biases in chronic pain patients: A preliminary study. *European Journal of Pain, 8*(6), 585-594.

Dekker, J., & Everaerd, W. (1989). A study suggesting two kinds of information processing of the sexual response. *Archives of Sexual Behavior*, *18*(5), 435-447.

Dias, E. C., & Bruce, C. J. (1994). Physiological correlate of fixation disengagement in the primate's frontal eye field. *Journal of Neurophysiology, 72*(5), 2532-2537.

Dove, N. L., & Wiederman, M. W. (2000). Cognitive distraction and women's sexual functioning. *Journal of Sex & Marital Therapy, 26*(1), 67-78.

Ehrman, R. N., Robbins, S. J., Bromwell, M. A., Lankford, M. E., Monterosso, J. R., & O'Brien, C. P. (2002). Comparing attentional bias to smoking cues in current smokers, former smokers, and non-smokers using a dot-probe task. *Drug & Alcohol Dependence, 67*(2), 185-191.

Elliott, A. N., & O'Donohue, W. T. (1997). The effects of anxiety and distraction on sexual arousal in a nonclinical sample of heterosexual women. *Archives of Sexual Behavior, 26*(6), 607-624.

Eltiti, S., Wallace, D., & Fox, E. (2005). Selective target processing: Perceptual load or distractor salience? *Perception & Psychophysics, 67*(5), 876-885.

Everaerd, W. (1988). Commentary on sex research: Sex as an emotion. *Journal of Psychology & Human Sexuality, 1*(2), 3-15.

Everaerd, W., & Both, S. (2001). Ideal female sexual function. *Journal of Sex & Marital*

Therapy. Special Issue: Historical and International Context of Nosology of Female Sexual Disorders, 27(2), 137-139.

Everaerd, W., & Both, S. (2001). Ideal female sexual function. *Journal of Sex & Marital Therapy. Special Issue: Historical and International Context of Nosology of Female Sexual Disorders, 27*(2), 137-139.

Fahrion, S. L., Walters, E. D., Coyne, L., & Allen, T. (1992). Alterations in EEG amplitude, personality factors, and brain electrical mapping after alpha-theta brainwave training: A controlled case study of an alcoholic in recovery. *Alcoholism: Clinical & Experimental Research, 16*(3), 547-552.

Fisher, W. A., Byrne, D., White, L. A., & Kelley, K. (1988). Erotophobia-erotophilia as a dimension of personality. *Journal of Sex Research*, *25*(1), 123-151.

Fortenberry, J. D., Cech, H., Zimet, G. D., & Orr, D. P. (1997). Concordance between self-report questionnaires and coital diaries for sexual behaviors of adolescent women with sexually transmitted infections. In J. Bancroft (Ed.), *Researching sexual behavior: Methodological issues* (pp. 237-257). Bloomington: Indiana University Press.

Fox, E., Russo, R., & Dutton, K. (2002). Attentional bias for threat: Evidence for delayed disengagement from emotional faces. *Cognition & Emotion, 16*(3), 355-379.

Frijda, N. H. (1986). *The emotions*. New York: Cambridge University Press.

Garde, K., & Lunde, I. (1980). Female sexual behaviour. A study in a random sample of 40-year-old women. *Maturitas*, *2*(3), 225-240.

Geer, J. H., & Bellard, H. S. (1996). Sexual content induced delays in unprimed lexical decisions: Gender and context effects. *Archives of Sexual Behavior, 25*(4), 379-395.

Geer, J. H., Judice, S., & Jackson, S. (1994). Reading times for erotic material: The pause to reflect. *Journal of General Psychology, 121*(4), 345-352.

Geer, J. H., & McGlone, M. S. (1990). Sex differences in memory for erotica. *Cognition & Emotion. Special Issue: Evaluative conditioning, 4*(1), 71-78.

Gemma, M. L., & Brunstrom, J. M. (2005). Everyday dietary behaviour and the relationship between attention and meal size. *Appetite, 45*(3), 344-355.

Georgiou, G. A., Bleakley, C., Hayward, J., Russo, R., Dutton, K., Eltiti, S., et al. (2005). Focusing on fear: Attentional disengagement from emotional faces. *Visual Cognition, 12*(1), 145-158.

Giargiari, T. D., Mahaffey, A. L., Craighead, W. E., & Hutchison, K. E. (2005). Appetitive Responses to Sexual Stimuli Are Attenuated in Individuals with Low Levels of Sexual Desire. *Archives of Sexual Behavior, 34*(5), 547 - 556.

Glabus, M. F., Blackwood, D. H. R., Ebmeier, K. P., Souza, V., & et al. (1994). Methodological considerations in measurement of the P300 component of the auditory oddball ERP in schizophrenia. *Electroencephalography & Clinical Neurophysiology, 90*(2), 123-134.

Graham, C. A., & Sanders, S. A. (2002). *Turning on and turning off: Factors that affect women's sexual arousal.* Paper presented at the Annual meeting of the International Society for the Study of Women's Sexual Health, Vancouver.

Gratton, G., Coles, M. G., & Donchin, E. (1983). A new method for off-line removal of ocular artifact. *Electroencephalography & Clinical Neurophysiology, 55*(4), 468-484.

Gray, H. M., Ambady, N., Lowenthal, W. T., & Deldin, P. (2004). P300 as an index of attention to self-relevant stimuli. *Journal of Experimental Social Psychology, 40*(2), 216-224.

Gray, J. A. (1987). Perspectives on anxiety and impulsivity: A commentary. *Journal of Research in Personality, 21*(4), 493-509.

Greenhouse, S. W., & Geisser, S. (1959). On methods in the analysis of profile data. *Psychometrika, 24*.

Greenwald, A., McGhee, D., & Schwartz, J. (1998). Measuring individual differences in implicit cognition: The implicit associations test. *Journal of Personality and Social Psychology, 74*(6), 1464-1480.

Haake, P., Schedlowski, M., Exton, M. S., Giepen, C., Hartmann, U., Osterheider, M., et al. (2003). Acute Neuroendocrine Response to Sexual Stimulation in Sexual Offenders. *Canadian Journal of Psychiatry, 48*(4), 265-271.

Haerich, P., & Khoury, L. (1994). Erotophobia, erotophilia, and startle modification: Differences in affective responding to the same stimulus. *Psychophysiology, 31*, S54.

Hansenne, M. (1999). P300 and personality: An investigation with the Cloninger's model. *Biological Psychology, 50*(2), 143-155.

Haselton, M. G., & Buss, D. M. (2001). The affective shift hypothesis: The functions of emotional changes following sexual intercourse. *Personal Relationships. Special Issue: Evolutionary approaches to relationships, 8*(4), 357-369.

Heiman, J. R., & Meston, C. M. (1997). Empirically validated treatment for sexual dysfunction. *Annual Review of Sex Research, 3,* 148-194.

Heiman, J. R., & Rowland, D. L. (1983). Affective and physiological sexual response patterns: The effects of instructions on sexually functional and dysfunctional men. *Journal of Psychosomatic Research*, *27*(2), 105-116.

Hill, C. A., & Preston, L. K. (1996). Individual differences in the experience of sexual motivation: Theory and measurement of dispositional sexual motives. *Journal of Sex Research, 33*(1), 27-45.

Hoffmann, H., Janssen, E., & Turner, S. L. (2004). Classical Conditioning of Sexual Arousal in Women and Men: Effects of Varying Awareness and Biological Relevance of the Conditioned Stimulus. *Archives of Sexual Behavior, 33*(1), 43-53.

Hogarth, L. C., Mogg, K., Bradley, B. P., Duka, T., & Dickinson, A. (2003). Attentional orienting towards smoking-related stimuli. *Behavioural Pharmacology, 14*(2), 153-160.

Hong, L. E., Summerfelt, A., McMahon, R. P., Thaker, G. K., & Buchanan, R. W. (2004). Gamma/beta oscillation and sensory gating deficit in schizophrenia. *Neuroreport: For Rapid Communication of Neuroscience Research, 15*(1), 155-159.

Houle, T. T., Dhingra, L. K., Remble, T. A., Rokicki, L. A., & Penzien, D. B. (2006). Not Tonight, I Have a Headache? *Headache, 46*, 983-990.

Hurlbert, D. (1993). A comparative study using orgasm consistency training in the treatment of women reporting hypoactive sexual desire. *Journal of Sex and Marital Therapy, 19*(1), 44-55.

Hurlbert, D. F., & Apt, C. (1994). Female sexual desire, response, and behavior. *Behavior Modification, 18*(4), 488-504.

Irvine, J. M. (1993). Regulated Passions: The Invention of Inhibited Sexual Desire and Sex Addiction. *Social Text, 37*, 203-226.

Jacobs, G. D., Benson, H., & Friedman, R. (1996). Topographic EEG mapping of the relaxation response. *Biofeedback & Self Regulation, 21*(2), 121-129.

Jansen, D. M., & Frijda, N. H. (1994). Modulation of the acoustic startle response by film-induced fear and sexual arousal. *Psychophysiology, 31*(6), 565-571.

Janssen, E., & Bancroft, J. (2006). The Dual-Control Model: The role of sexual inhibition & excitation in sexual arousal and behavior. In E. Janssen (Ed.), *The Psychophysiology of*

Sex. Bloomington: Indiana University press.

Janssen, E., Everaerd, W., Spiering, M., & Janssen, J. (2000). Automatic processes and the appraisal of sexual stimuli: Toward an information processing model of sexual arousal. *Journal of Sex Research, 37*(1), 8-23.

Janssen, E., Vorst, H., Finn, P., & Bancroft, J. (2002). The Sexual Inhibition (SIS) and Sexual Excitation (SES) Scales: I. Measuring sexual inhibition and excitation proneness in men. *Journal of Sex Research, 39*(2), 114-126.

Janssen, E., Vorst, H., Finn, P., & Bancroft, J. (2002). The Sexual Inhibition (SIS) and Sexual Excitation (SES) Scales: II. Predicting psychophysiological response patterns. *Journal of Sex Research, 39*(2), 127-132.

Jiang, Y., Saxe, R., & Kanwisher, N. (2004). Functional magnetic resonance imaging provides new constraints on theories of the psychological refractory period. *Psychological Science, 15*(6), 390-396.

Johansson, L., Ghaderi, A., & Andersson, G. (2004). The role of sensitivity to external food cues in attentional allocation to food words on dot probe and Stroop tasks. *Eating Behaviors, 5*(3), 261-271.

Johnson, S. D., Phelps, D. L., & Cottler, L. B. (2004). The Association of Sexual Dysfunction and Substance Use Among a Community Epidemiological Sample. *Archives of Sexual Behavior, 33*(1), 55-63.

Justus, A. N., Finn, P. R., & Steinmetz, J. E. (2001). P300, disinhibited personality, and early-onset alcohol problems. *Alcoholism: Clinical & Experimental Research, 25*(10), 1457-1466.

Kaplan, H. (1979). *Disorders of Sexual Desire and Other New Concepts and Techniques in Sex*

Therapy. New York: Simon & Schuster.

King, B. E., & Allgeier, E. R. (2000). The Sexual Desire Inventory as a measure of sexual motivation in college students. *Psychological Reports, 86*(1), 347-350.

Klimesch, W., Schack, B., & Sauseng, P. (2005). The Functional Significance of Theta and Upper Alpha Oscillations. *Experimental Psychology, 52*(2), 99-108.

Koster, E. H. W., Crombez, G., Verschuere, B., & De Houwer, J. (2004). Selective attention to threat in the dot probe paradigm: Differentiating vigilance and difficulty to disengage. *Behaviour Research & Therapy, 42*(10), 1183-1192.

Koukounas, E., & McCabe, M. P. (1997). Sexual and emotional variables influencing sexual response to erotica. *Behaviour Research & Therapy, 35*(3), 221-231.

Koukounas, E., & McCabe, M. P. (2001). Sexual and emotional variables influencing sexual response to erotica: A psychophysiological investigation. *Archives of Sexual Behavior, 30*(4), 393-408.

Koukounas, E., & Over, R. (1999). Allocation of attentional resources during habituation and dishabituation of male sexual arousal. *Archives of Sexual Behavior, 28*(6), 539-552.

Krug, R., Plihal, W., Fehm, H. L., & Born, J. (2000). Selective influence of the menstrual cycle on perception of stimuli with reproductive significance: An event-related potential study. *Psychophysiology, 37*(1), 111-122.

Kuffel, S. W., & Heiman, J. (2006). Effects of Depressive Symptoms and Experimentally Adopted Schemas on Sexual Arousal and Affect in Sexually Healthy Women. *Archives of Sexual Behavior, 35*(2), 160-174.

Laan, E., Everaerd, W., Van Berlo, R., & Rijs, L. (1995). Mood and sexual arousal in women. *Behaviour Research & Therapy, 33*(4), 441-443.

LaBerge, D., Auclair, L., & Sieroff, E. (2000). Preparatory attention: Experiment and theory. *Consciousness & Cognition: An International Journal, 9*(3), 396-434.

Landry, R., & Bryson, S. E. (2004). Impaired disengagement of attention in young children with autism. *Journal of Child Psychology & Psychiatry, 45*(6), 1115-1122.

Landry, R., & Bryson, S. E. (2004). Impaired disengagement of attention in young children with autism. *Journal of Child Psychology & Psychiatry, 45*(6), 1115-1122.

Lang, A. R., Searles, J., Lauerman, R., & Adesso, V. J. (1980). Expectancy, alcohol, and sex guilt as determinants of interest in and reaction to sexual stimuli. *Journal of Abnormal Psychology, 89*(5), 644-653.

Lang, P. J. (1968). Fear reduction and fear behavior: Problems in treating a construct. In J. M. Schlien (Ed.), *Research in psychoptherapy* (Vol. 3). Washington, DC: American Psychological Association.

Lang, P. J. (1993). The motivational organization of emotion: Affect reflex connections. In S. van Goozen, N. E. van der Poll & J. A. Sergeant (Eds.), *The emotions: Essays on emotion theory* (pp. 61-96). Hillsdale, NJ: Erlbaum.

Lang, P. J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist, 50*(5), 372-385.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1992). A motivational analysis of emotion: Reflex-cortex connections. *Psychological Science, 3*(1), 44-49.

Larsen, R. J., & Diener, E. (1987). Affect intensity as an individual difference characteristic: A review. *Journal of Research in Personality, 21*(1), 1-39.

Larsen, R. J., & Diener, E. (1992). Promises and problems with the circumplex model of emotion. In M. S. Clark (Ed.), *Emotion. Review of personality and social psychology*

(Vol. No. 13, pp. 25-59). Thousand Oaks, CA: Sage Publications, Inc.

Larsen, R. J., Diener, E., & Emmons, R. A. (1986). Affect intensity and reactions to daily life events. *Journal of Personality and Social Psychology, 51*(4), 803-814.

Latta, R. M., & Patten, R. L. (1978). A test of Weiner's attribution theory inertial motivation hypothesis. *Journal of Personality, 46*(2), 383-399.

Laumann, E. O., Nicolosi, A., Glasser, D. B., Paik, A., Gingell, C., Moreira, E., et al. (2005). Sexual problems among women and men aged 40-80 y: prevalence and correlates identified in the Global Study of Sexual Attitudes and Behaviors. *International Journal of Impotence Research, 17*(1), 39-57.

Lazarus, R. S. (1982). Thoughts on the relations between emotion and cognition. *American Psychologist, 37*(9), 1019-1024.

Leitenberg, H., & Henning, K. (1995). Sexual fantasy. *Psychological Bulletin, 117*(3), 469-496.

Locke, S. D., & Gilbert, B. O. (1995). Method of psychological assessment, self-disclosure, and experiential differences: A study of computer, questionnaire, and interview assessment formats. *Journal of Social Behavior & Personality, 10*(1), 255-263.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin, 127*(2), 267-286.

Lyons, M. J., Koenen, K. C., Buchting, F., Meyer, J. M., Eaves, L., Toomey, R., et al. (2004). A Twin Study of Sexual Behavior in Men. *Archives of Sexual Behavior, 33*(2), 129-136.

Mackintosh, B., & Mathews, A. (2003). Don't look now: Attentional avoidance of emotionally valenced cues. *Cognition and Emotion, 17*(4), 623 - 646.

Mackintosh, B., & Mathews, A. (2003). Don't look now: Attentional avoidance of emotionally valenced cues. *Cognition and Emotion, 17*(4), 623 - 646.

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology, 95*(1), 15-20.

MacLeod, C., Rutherford, E., Campbell, L., Ebsworthy, G., & Holker, L. (2002). Selective attention and emotional vulnerability: Assessing the causal basis of their association through the experimental manipulation of attentional bias. *Journal of Abnormal Psychology, 111*(1), 107-123.

Mahaffey, A. L., Bryan, A., & Hutchison, K. E. (2005). Sex Differences in Affective Responses to Homoerotic Stimuli: Evidence for an Unconscious Bias Among Heterosexual Men, but not Heterosexual Women *Archives of Sexual Behavior*, *34*(5), 537-545.

Mahaffey, A. L., Bryan, A., & Hutchison, K. E. (2005). Using Startle Eye Blink to Measure the Affective Component of Antigay Bias. *Basic and Applied Social Psychology*, *27*(1), 37-45.

Manguno Mire, G. M., & Geer, J. H. (1998). Network knowledge organization: Do knowledge structures for sexual and emotional information reflect gender or sexual orientation? *Sex Roles, 39*(9-10), 705-729.

Margolese, H. C., & Assalian, P. (1996). Sexual side effects of antidepressants: A review. *Journal of Sex and Marital Therapy, 22*(3), 209-217.

Massaro, D. W., & Cowan, N. (1993). Information processing models: Microscopes of the mind. *Annual Review of Psychology, 44*, 383-425.

Masters, W., & Johnson, V. (1970). *Human Sexual Inadequacy*. Boston: Brown.

Masters, W. H., & Johnson, V. E. (1976). *Principles of the new sex therapy*. Boston: Little, Brown.

Mathews, A., & MacLeod, C. (2002). Induced processing biases have causal effects on anxiety.

Cognition & Emotion, 16(3), 331-354.

McCabe, S. B., & Gotlib, I. H. (1995). Selective attention and clinical depression: Performance on a deployment-of-attention task. *Journal of Abnormal Psychology, 104*(1), 241-245.

Meston, C. M. (2003). Validation of the Female Sexual Function Index (FSFI) in women with female orgasmic disorder and in women with hypoactive sexual desire disorder. *Journal of Sex & Marital Therapy, 29*(1), 39-46.

Meston, C. M. (2006). The effects of state and trait self-focused attention on sexual arousal in sexually functional and dysfunctional women *Behaviour research and therapy, 44*(4), 515-532.

Meston, C. M., Heiman, J. R., Trapnell, P. D., & Paulhus, D. L. (1998). Socially desirable responding and sexuality self-reports. *Journal of Sex Research, 35*(2), 148-157.

Meuleman, E. J. H., & van Lankveld, J. J. D. M. (2005). Hypoactive sexual desire disorder: an underestimated condition in men. *BJU Int, 95*(3), 291-296.

Miller, M. W., Patrick, C. J., & Levenston, G. K. (2002). Affective imagery and the startle response: Probing mechanisms of modulation during pleasant scenes, personal experiences and discrete negative emotions. *Psychophysiology, 39*(4), 519-529.

Mitchell, W. B., DiBartolo, P. M., Brown, T. A., & Barlow, D. H. (1998). Effects of positive and negative mood on sexual arousal in sexually functional males. *Archives of Sexual Behavior, 27*(2), 197-207.

Mogg, K., Bradley, B. P., De Bono, J., & Painter, M. (1997). Time course of attentional bias for threat information in non-clinical anxiety. *Behaviour Research & Therapy, 35*(4), 297-303.

Morita, Y., Morita, K., Yamamoto, M., Waseda, Y., & Maeda, H. (2001). Effects of facial affect recognition on the auditory P300 in healthy subjects. *Neuroscience Research, 41*(1), 89-95.

Musa, C., Lepine, J. P., Clark, D. M., Mansell, W., & Ehlers, A. (2003). Selective attention in social phobia and the moderating effect of a concurrent depressive disorder. *Behaviour Research & Therapy, 41*(9), 1043-1059.

Mustanski, B. S. (2003). A therapist's guide to the genetics of human sexual orientation. *Sexual and Relationship Therapy, 18*(4), 429-436.

Nathan, S. G. (1986). The epidemiology of the DSM-III psychosexual dysfunctions. *Journal of Sex & Marital Therapy, 12*(4), 267-281.

Navon, D., & Margalit, B. (1983). Allocation of attention according to informativeness in visual recognition. *Quarterly Journal of Experimental Psychology A: Human Experimental Psychology, 35*(3-A), 497-512.

O'Donnell, B. F., Faux, S. F., McCarley, R. W., Kimble, M. O., Salisbury, D. F., Nestor, P. G., et al. (1995). Increased rate of P300 latency prolongation with age in schizophrenia: Electrophysiological evidence for a neurodegenerative process. *Archives of General Psychiatry, 52*(7), 544-549.

Palace, E. M. (1995). Modification of dysfunctional patterns of sexual response through automatic arousal and false physiological feedback. *Journal of Consulting & Clinical Psychology, 63*(5), 604-615.

Palace, E. M., & Gorzalka, B. B. (1990). The enhancing effects of anxiety on arousal in sexually dysfunctional and functional women. *Journal of Abnormal Psychology, 99*(4), 403-411.

Papanicolaou, A. C., Loring, D. W., Deutsch, G., & Eisenberg, H. M. (1986). Task-related EEG asymmetries: a comparison of alpha blocking and beta enhancement. *Int J Neurosci,* *30*(1-2), 81-85.

Park, K., Goldstein, I., Andry, C., Siroky, M. B., Krane, R. J., & Azadzoi, K. M. (1997). Vasculogenic female sexual dysfunction: the hemodynamic basis for vaginal engorgement insufficiency and clitoral erectile insufficiency. *International Journal of Impotence Research, 9*(1), 27-37.

Patrick, C. J. (1994). Emotion and psychopathy: Startling new insights. *Psychophysiology, 31*(4), 319-330.

Picton, T. W., Bentin, S., Berg, P., Donchin, E., Hillyard, S. A., Johnson, R., Jr., et al. (2000). Guidelines for using human event-related potentials to study cognition: Recording standards and publication criteria. *Psychophysiology, 37*(2), 127-152.

Posner, M. I., & Cohen, Y. (1984). Components of visual orienting. In H. Bouma & D. Bouwhuis (Eds.), *Attention and performance* (pp. 531-556). London: Erlbaum.

Post, L. L. (1994). Sexual side effects of psychiatric medications in women. *American Journal of Psychiatry, 151*(8), 1247.

Prause, N., Janssen, E., & Hetrick, W. P. (2006) Attention and emotional responses to sexual stimuli and their relationship to sexual desire. Manuscript submitted for publication.

Prause, N., Ames, K., Stout, K., Kieffaber, P., & Hetrick, W. P. (2006). Differential effects of affective modulation on orbicularis and post-auricular indices of startle. Manuscript submitted for publication.

Raymond, J. E., Fenske, M. J., & Tavassoli, N. T. (2003). Selective attention determines emotional responses to novel visual stimuli. *Psychological Science, 14*(6), 537-542.

Remington, N. A., Fabrigar, L. R., & Visser, P. S. (2000). Reexamining the circumplex model of affect. *Journal of Personality & Social Psychology, 79*(2), 286-300.

Riley, A., & Riley, E. (2000). Controlled studies on women presenting with sexual drive disorder: I. Endocrine status. *Journal of Sex & Marital Therapy, 26*(3), 269-283.

Rinck, M., Becker, E. S., Kellermann, J., & Roth, W. T. (2003). Selective attention in anxiety: Distraction and enhancement in visual search. *Depression & Anxiety, 18*(1), 18-28.

Rook, K. S., & Hammen, C. L. (1977). A cognitive perspective on the experience of sexual arousal. *Journal of Social Issues, 33*(2), 7-29.

Rosen, R., Brown, C., Heiman, J., Leiblum, S., Meston, C., Shabsigh, R., et al. (2000). The Female Sexual Function Index (FSFI): A multidimensional self-report instrument for the assessment of female sexual function. *Journal of Sex & Marital Therapy, 26*(2), 191-208.

Rosen, R. C., & Leiblum, S. R. (1987). Current approaches to the evaluation of sexual desire disorders. *Journal of Sex Research, 23*(2), 141-162.

Rosen, R. C., Riley, A., Wagner, G., Osterloh, I. H., Kirkpatrick, J., & Mishra, A. (1997). The international index of erectile function (IIEF): a multidimensional scale for assessment of erectile dysfunction. *Urology, 49*(6), 822-830.

Sapir, A., Henik, A., Dobrusin, M., & Hochman, E. Y. (2001). Attentional asymmetry in schizophrenia: Disengagement and inhibition of return deficits. *Neuropsychology, 15*(3), 361-370.

Sbraga, T. P., & O'Donohue, W. T. (2004). *The Sex Addiction Workbook: Proven Strategies to Help You Regain Control of Your Life* (Vol. from Amazon 5/20/06:

Sbrocco, T., & Barlow, D. H. (1996). Conceptualizing the cognitive component of sexual arousal: Implications for sexuality research and treatment. In P. M. Salkovskis (Ed.), *Frontiers of cognitive therapy* (pp. 419-449). New York, NY: Guilford Press.

Segraves, K. B., & Segraves, R. T. (1991). Hypoactive sexual desire disorder: Prevalence and comorbidity in 906 subjects. *Journal of Sex & Marital Therapy, 17*(1), 55-58.

Segraves, R., & Woodard, T. (2006). Female Hypoactive Sexual Desire Disorder: History and Current Status. *The Journal of Sexual Medicine, 3*(3), 408-418.

Simons, J. S., & Carey, M. P. (2001). Prevalence of sexual dysfunctions: Results from a decade of research. *Archives of Sexual Behavior, 30,* 177-219.

Skolnick, A. J., & Davidson, R. J. (2002). Affective modulation of eyeblink startle with reward and threat. *Psychophysiology, 39,* 835-850.

Slob, A. K., Bax, C. M., Hop, W. C. J., Rowland, D. L., & van der Werff ten Bosch, J. J. (1996). Sexual arousability and the menstrual cycle. *Psychoneuroendocrinology, 21*(6), 545-558.

Smith, J. C., Bradley, M. M., & Lang, P. J. (2005). State anxiety and affective physiology: Effects of sustained exposure to affective pictures. *Biological Psychology, 69*(3), 247-260.

Smith, P., & Waterman, M. (2003). Processing bias for aggression words in forensic and nonforensic samples. *Cognition & Emotion, 17*(5), 681-701.

Spanier, G. B. (1976). Measuring dyadic adjustment: New scales for assessing the quality of marriage and similar dyads. *Journal of Marriage & the Family, 38*(1), 15-28.

Spector, I., Carey, M., & Steinberg, L. (1996). The Sexual Desire Inventory: Development, factor structure, and evidence of reliability. *Journal of Sex & Marital Therapy, 22*(3), 175-190.

Spiering, M., Everaerd, W., & Elzinga, B. (2002). Conscious processing of sexual information: Interference caused by sexual primes. *Archives of Sexual Behavior, 31*(2), 159-164.

Stoleru, S., Redoute, J., Costes, N., Lavenne, F., Bars, D., Dechaud, H., et al. (2003). Brain processing of visual sexual stimuli in men with hypoactive sexual desire disorder.

Psychiatry Research, 124(2), 67-86.

Tellegen, A., & Atkinson, G. (1974). Openness to absorbing and self-altering experiences ("absorption"), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology, 83*(3), 268-277.

Tiefer, L. (2001). A new view of women's sexual problems: Why new? Why now. *Journal of Sex Research, 38*(2), 89-96.

Tipples, J., & Sharma, D. (2000). Orienting to exogenous cues and attentional bias to affective pictures reflect separate processes. *British Journal of Psychology, 91*(1), 87-97.

Townshend, J. M., & Duka, T. (2001). Attentional bias associated with alcohol cues: Differences between heavy and occasional social drinkers. *Psychopharmacology, 157*(1), 67-74.

Treas, J., & Giesen, D. (2000). Sexual Infidelity Among Married and Cohabiting Americans. *Journal of Marriage and Family, 62*(1), 48-60.

Trudel, G., Marchand, A., Ravart, M., Aubin, S., Turgeon, L., & Fortier, P. (2001). The effect of a cognitive-behavioral group treatment program on hypoactive sexual desire in women. *Sexual & Relationship Therapy. Special Issue:, 16*(2), 145-164.

van Lunsen, R. H., & Laan, E. (1997). Sex, hormones and the brain. *Eur J Contracept Reprod Health Care, 2*(4), 247-251.

Vanman, E. J., Boehmelt, A. H., Dawson, M. E., & Schell, A. M. (1996). The varying time courses of attentional and affective modulation of the startle eyeblink reflex. *Psychophysiology, 33*(6), 691-697.

Vanman, E. J., Paul, B. Y., Ito, T. A., & Miller, N. (1997). The Modern Face of Prejudice and Structural Features That Moderate the Effect of Cooperation on Affect. *Journal of Personality and Social Psychology, 73*(5), 941-959.

Vrana, S. R., Spence, E. L., & Lang, P. J. (1988). The startle probe response: A new measure of emotion? *Journal of Abnormal Psychology, 97*(4), 487-491.

Wade, W. A., Treat, T. A., & Stuart, G. L. (1998). Transporting an empirically supported treatment for panic disorder to a service clinic setting: A benchmarking strategy. *Journal of Consulting & Clinical Psychology, 66*(2), 231-239.

Waismann, R., Fenwick, P. B., Wilson, G. D., Hewett, T. D., & Lumsden, J. (2003). EEG responses to visual erotic stimuli in men with normal and paraphilic interests. *Archives of sexual behavior, 32*(2), 135-144.

Wallstrom, G. L., Kass, R. E., Miller, A., Cohn, J. F., & Fox, N. A. (2004). Automatic correction of ocular artifacts in the EEG: a comparison of regression-based and component-based methods. *International Journal of Psychophysiology, 53*(2), 105-119.

Warnock, J. J. K. (2002). Female Hypoactive Sexual Desire Disorder: Epidemiology, Diagnosis and Treatment. *CNS Drugs, 16*(11), 745-753.

Warnock, J. J. K., Bundren, J. C., & Morris, D. W. (1997). Female hypoactive sexual desire disorder due to androgen deficiency: Clinical and psychometric issues. *Psychopharmacology Bulletin, 33*(4), 761-766.

Wascher, E., & Tipper, S. P. (2004). Revealing effects of noninformative spatial cues: An EEG study of inhibition of return. *Psychophysiology, 41*(5), 716-728.

Watson, D. G., & Humphreys, G. W. (2000). Visual marking: Evidence for inhibition using a probe-dot detection paradigm. *Perception & Psychophysics, 62*(3), 471-481.

Weisberg, R. B., Brown, T. A., Wincze, J. P., & Barlow, D. H. (2001). Causal attributions and male sexual arousal: The impact of attributions for a bogus erectile difficulty on sexual arousal, cognitions, and affect. *Journal of Abnormal Psychology, 110*(2), 324-334.

Whalen, R. (1966). Sexual motivation. *Psychological Review, 73*, 151-163.

Wiegel, M., Meston, C., & Rosen, R. (2005). The Female Sexual Function Index (FSFI): Cross-Validation and Development of Clinical Cutoff Scores. *Journal of Sex & Marital Therapy, 31*(1), 1-20.

Wiegel, M., Scepkowski, L. A., & Barlow, D. H. (2006). Cognitive and affective processes in female sexual dysfunctions. In I. Goldstein, C. M. Meston, S. R. Davis & A. M. Traish (Eds.), *Women's sexual function and dysfunction: Study, diagnosis and treatment* (pp. 85-92). London: Taylor & Francis.

Wiegel, M., Scepkowski, L. A., & Barlow, D. H. (2006). Cognitive-Affective Processes in Sexual Arousal and Sexual Dysfunction. In E. Janssen (Ed.), *The Psychophysiology of Sex*. Bloomington, IN: Indiana University Press.

Wilson, G. T. (1977). Alcohol and human sexual behavior. *Behaviour Research and Therapy, 15*(3), 239-252.

Wincze, J. P., Venditti, E., Barlow, D., & Mavissakalian, M. (1980). The effects of a subjective monitoring task in the physiological measure of genital response to erotic stimulation. *Archives of Sexual Behavior, 9*(6), 533-545.

Wolchik, S. A., Beggs, V., Wincze, J. P., Sakheim, D. K., Barlow, D. H., & Sakalian, M. (1980). The effect of emotional arousal on subsequent sexual arousal in men. *Journal of Abnormal Psychology, 89*(4), 595-598.

Wright, L. W., Jr., & Adams, H. E. (1999). The effects of stimuli that vary in erotic content on cognitive processes. *Journal of Sex Research, 36*(2), 145-151.

Yiend, J., & Mathews, A. (2001). Anxiety and attention to threatening pictures. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology, 54A*(3), 665-

681.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35*(2), 151-175.

Zeelenberg, M., van Dijk, W. W., Manstead, A. S. R., & van der Pligt, J. (2000). On bad decisions and disconfirmed expectancies: The psychology of regret and disappointment. *Cognition & Emotion. Special Issue: Emotion, cognition, and decision making, 14*(4), 521-541.

Zion, I. B., Tessler, R., Cohen, L., Lerer, E., Raz, Y., Bachner-Melman, R., et al. (2006). Polymorphisms in the dopamine D4 receptor gene (DRD4) contribute to individual differences in human sexual behavior: desire, arousal and sexual function. *Molecular Psychiatry*, *1*, 1-5.

Table 1.

Sexual characteristics of sample by age and assigned sexual desire group

	Gender				**Sexual Desire Group**					
	Female		**Male**		**High**		**Medium**		**Low**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
No. sex partners	**11.2**	**14.4**	**14.8**	**25.8**	**14.0**	**16.3**	**8.6**	**7.4**	**16.5**	**31.5**
No. intercourse partners	**5.7**	**7.8**	**5.7**	**5.5**	**7.0**	**8.7**	**4.6**	**4.0**	**5.6**	**6.5**
Frequency of sex (typical month)[1]	**3.1**	**1.4**	**3.1**	**1.5**	**2.9**	**1.4**	**3.4**	**1.5**	**3.0**	**1.3**
Frequency of intercourse (typical month) [1]	**2.6**	**1.2**	**2.8**	**1.6**	**2.3**	**1.4**	**3.0**	**1.4**	**2.7**	**1.5**
Frequency of masturbation (typical month) [1]	**2.0**	**1.1**	**3.4**	**1.2**	**3.0**	**1.5**	**2.8**	**1.4**	**2.4**	**1.1**
Importance of sex[1]	**3.2**	**.9**	**3.2**	**1.1**	**3.2**	**1.2**	**3.1**	**.8**	**3.3**	**1.0**
Strength of sex problems[1]	**1.5**	**.9**	**1.6**	**.8**	**1.3**	**.6**	**1.5**	**.7**	**1.8**	**1.2**

[1] Absolute range is 1 to 5; higher scores indicate higher frequency or more problematic sexual functioning

Table 2.

Correlation of Sexual desire latent score and individual questionnaire measures

	Sexual Desire Latent factor score
Sexual Desire Inventory	
Dyadic	**.13**
Solitary	**.17**
Sexual Inhibition and Excitation Scales	
Sexual excitation	**.19**
Sexual inhibition I	**-.22**
Sexual inhibition II	**-.15**
Sociosexuality	
Erotophobia	**-.12**
Erotophilia	**.29***
Affect Intensity Measure	**.02**
Female Sexual Function Inventory	**.51****
International Index of Erectile Functioning	**.09**
Dyadic adjustment scale	**.00**

Table 3.

Average ratings of pleasantness, arousal, and sexual arousal within three assigned categories

Assigned category	**Pleasantness**		**Arousal**		**Sexual arousal**	
	M	**SD**	**M**	**SD**	**M**	**SD**
Women						
Pleasant	**6.18**	**1.06**	**6.24**	**1.66**	**4.76**	**1.21**
Neutral	**4.86**	**.70**	**3.14**	**1.26**	**1.71**	**.85**
Unpleasant	**2.14**	**.63**	**4.22**	**2.32**	**1.08**	**.20**
Men						
Pleasant	**6.79**	**1.03**	**6.96**	**1.78**	**5.20**	**1.06**
Neutral	**4.56**	**.88**	**3.25**	**1.16**	**1.44**	**.60**
Unpleasant	**2.14**	**.94**	**3.55**	**2.41**	**1.10**	**.26**

Figure captions

Figure 1. Barlow (1986) model of sexual functioning, used by permission from M. Wiegel.

Figure 2. Dot detection task diagram

Figure 3. Relationship of ratings of sexual pictures and Sexual desire level.

Figure 4. Startle eyeblink modulation by stimulus type (+/- 2 SE).

Figure 5. Postauricular rhetens modulation by stimulus type (+/- 2 SE).

*Figure 6.*SEM traces by content and by Sexual Desire Group

Figure 7. Postauricular rhetens modulation by stimulus type with sex stimuli separated (+/- 2 SE).

Figure 8. Dot detection task by pair type (+/- 1 SE).

Figure 9. Scatterplots of latent Sexual Desire score with bias scores (pleasant nonsexual – sexual)

Figure 10. Band power analyses.

Figure 11. Evoked response potentials at Pz by stimulus type.

Figure 12. Interaction of sexual desire group and emotional versus neutral stimuli at Oz.

Figure 1.

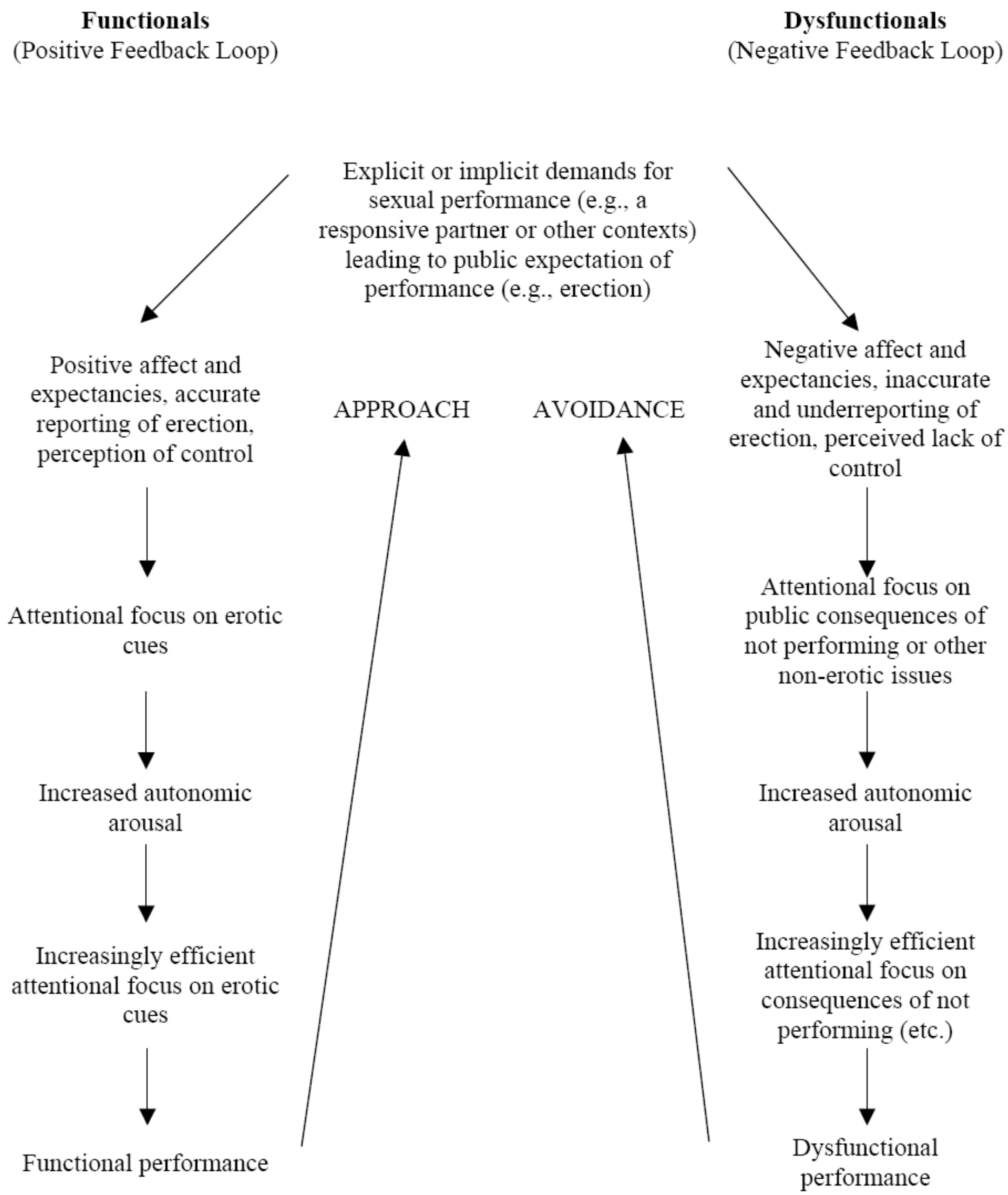

Functionals
(Positive Feedback Loop)
Dysfunctionals
(Negative Feedback Loop)
Explicit or implicit demands for sexual performance (e.g., a responsive partner or other contexts) leading to public expectation of performance (e.g., erection)
Positive affect and expectancies, accurate reporting of erection, perception of control
APPROACH
AVOIDANCE
Negative affect and expectancies, inaccurate and underreporting of erection, perceived lack of control
Attentional focus on erotic cues
Attentional focus on public consequences of not performing or other non-erotic issues
Increased autonomic arousal
Increased autonomic arousal
Increasingly efficient attentional focus on erotic cues
Increasingly efficient attentional focus on consequences of not performing (etc.)
Functional performance
Dysfunctional performance

Figure 2.

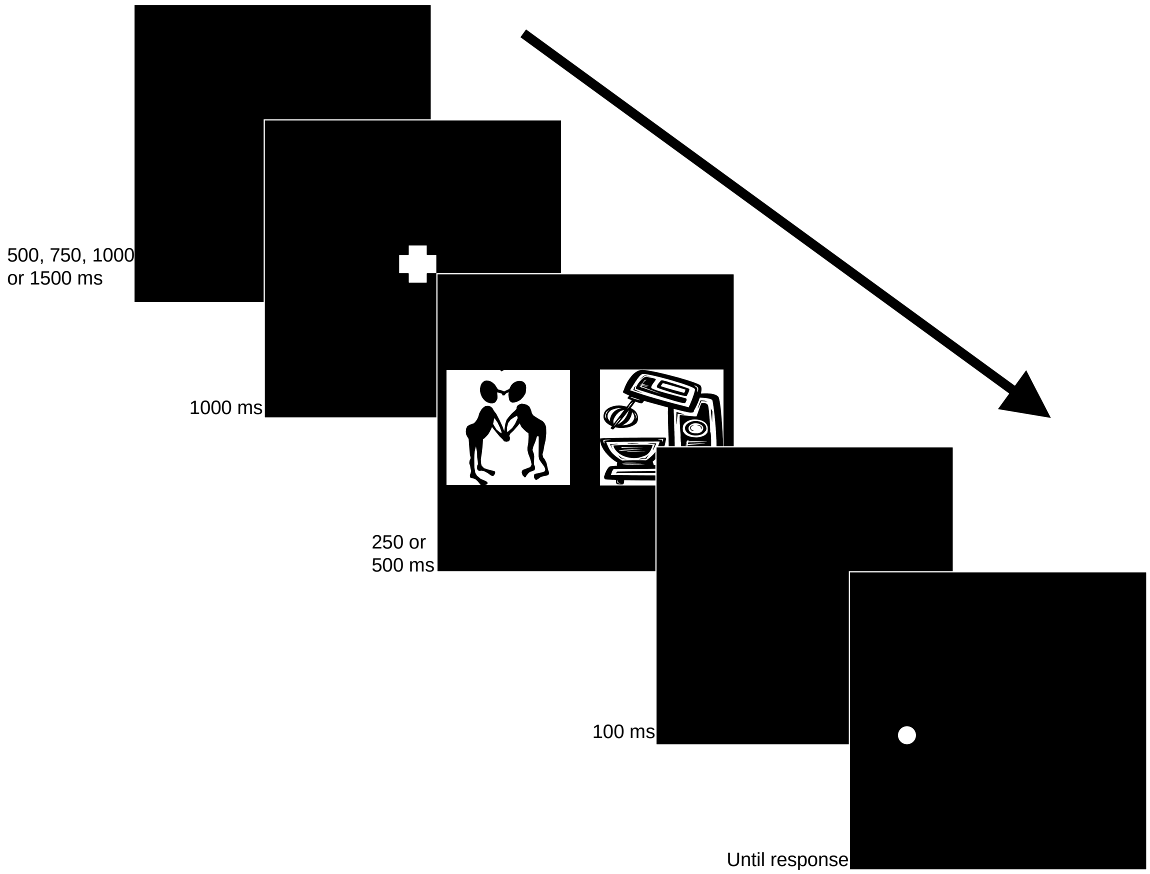

500, 750, 1000
or 1500 ms
1000 ms
250 or
500 ms
100 ms
Until response

Figure 3.

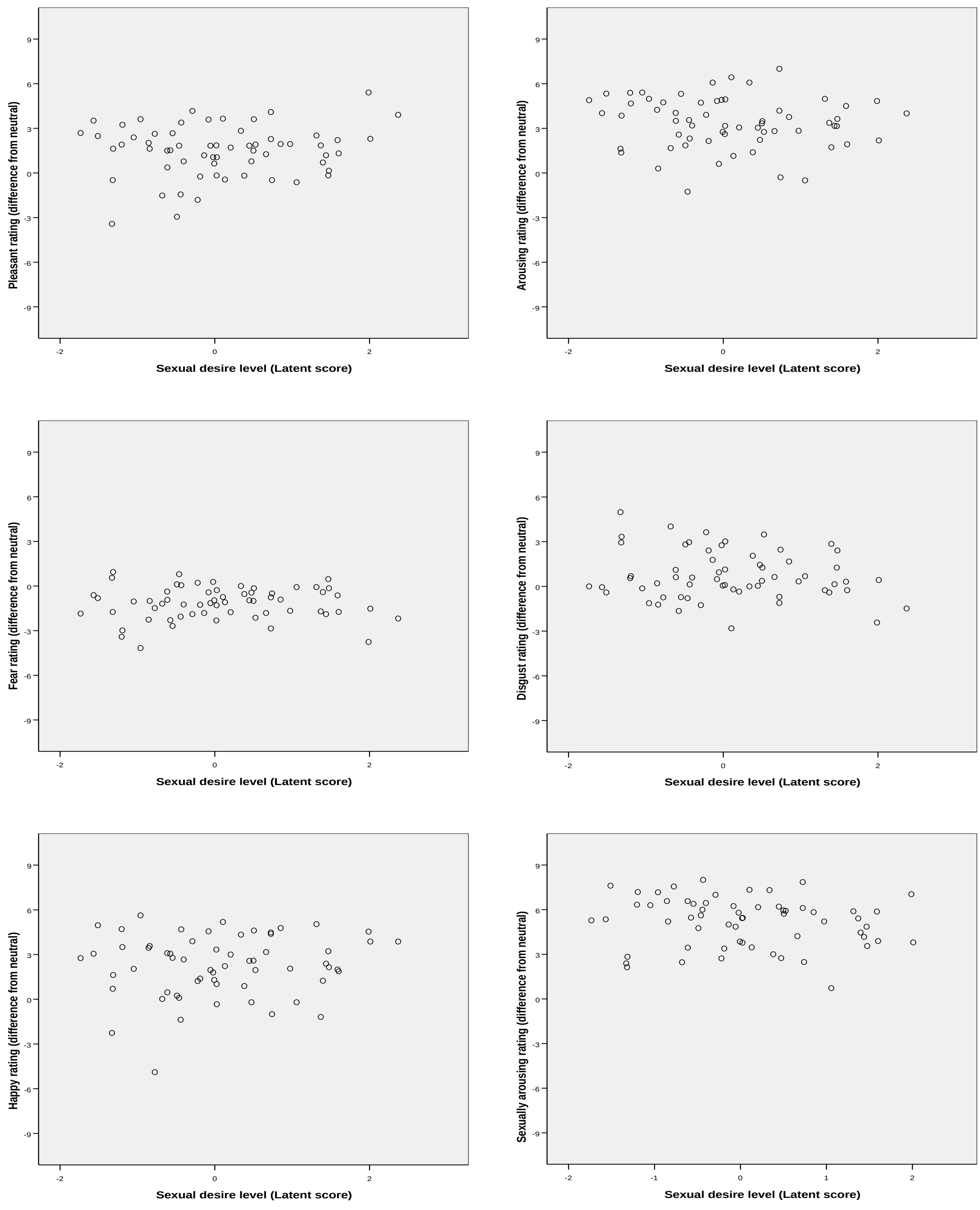
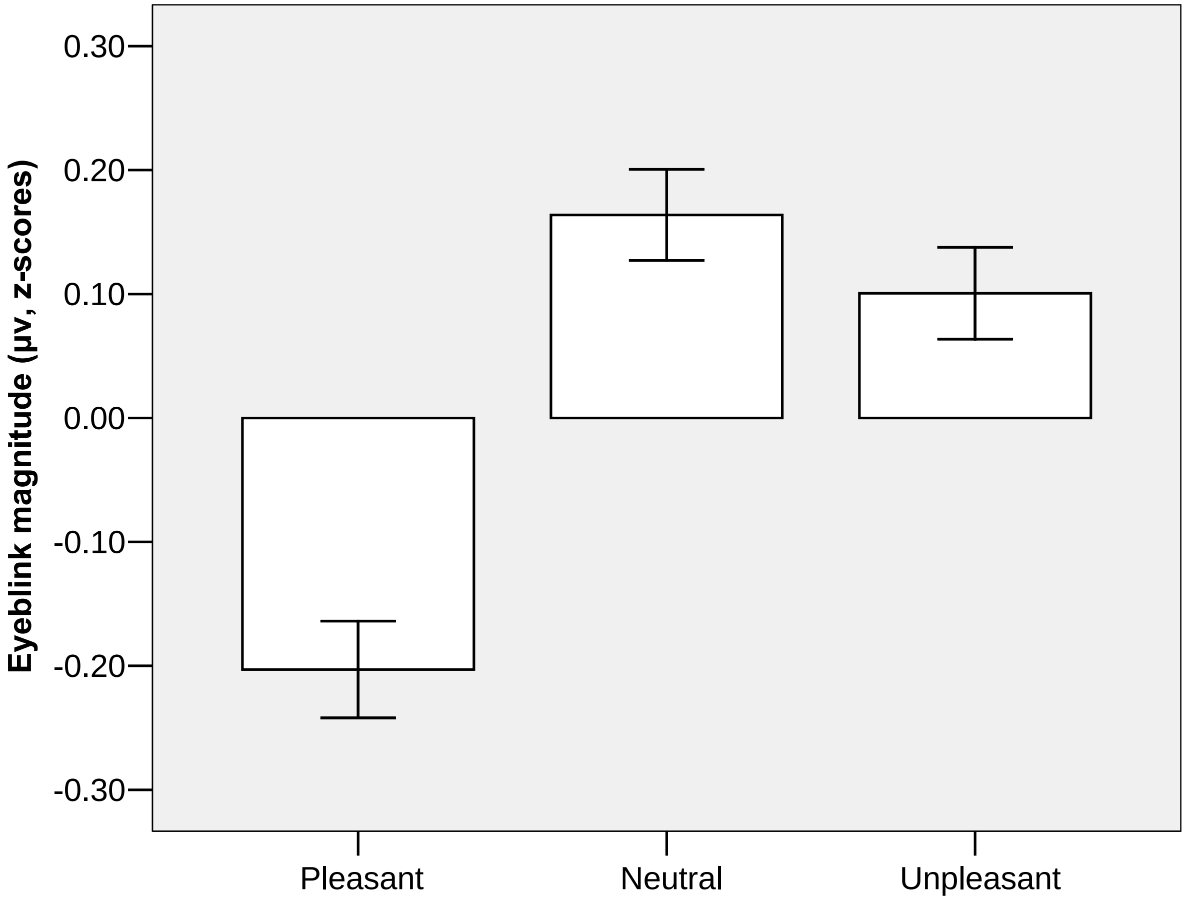

Pleasant rating (difference from neutral)
Arousing rating (difference from neutral)
Fear rating (difference from neutral)
Disgust rating (difference from neutral)
Happy rating (difference from neutral)
Sexually arousing rating (difference from neutral)
Sexual desire level (Latent score)
9
6
3
0
-3
-6
-9
-2
-1
0
1
2

Figure 4.



Eyeblink magnitude (µv, z-scores)
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
Pleasant
Neutral
Unpleasant

Figure 5.

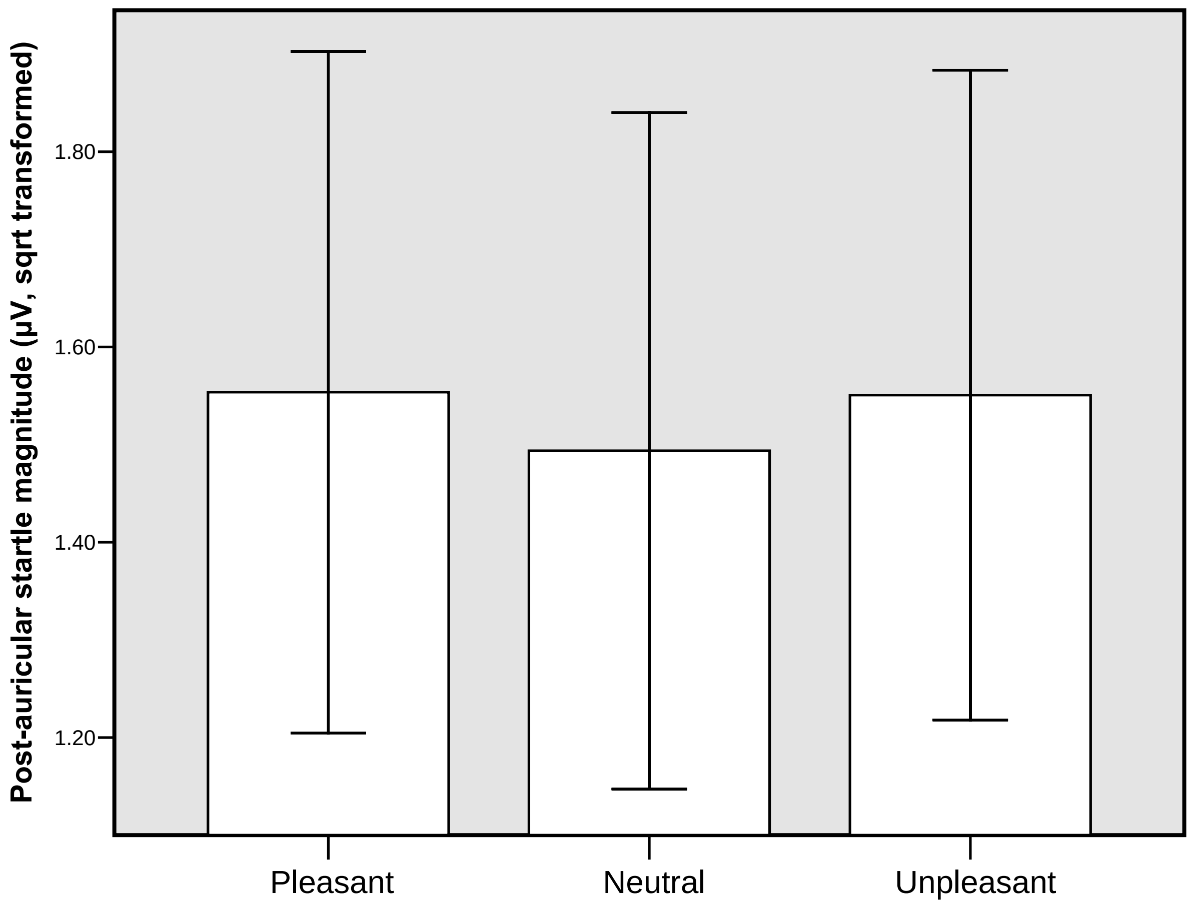

Post-auricular startle magnitude (µV, sqrt transformed)
1.80
1.60
1.40
1.20
Pleasant
Neutral
Unpleasant

Figure 6.

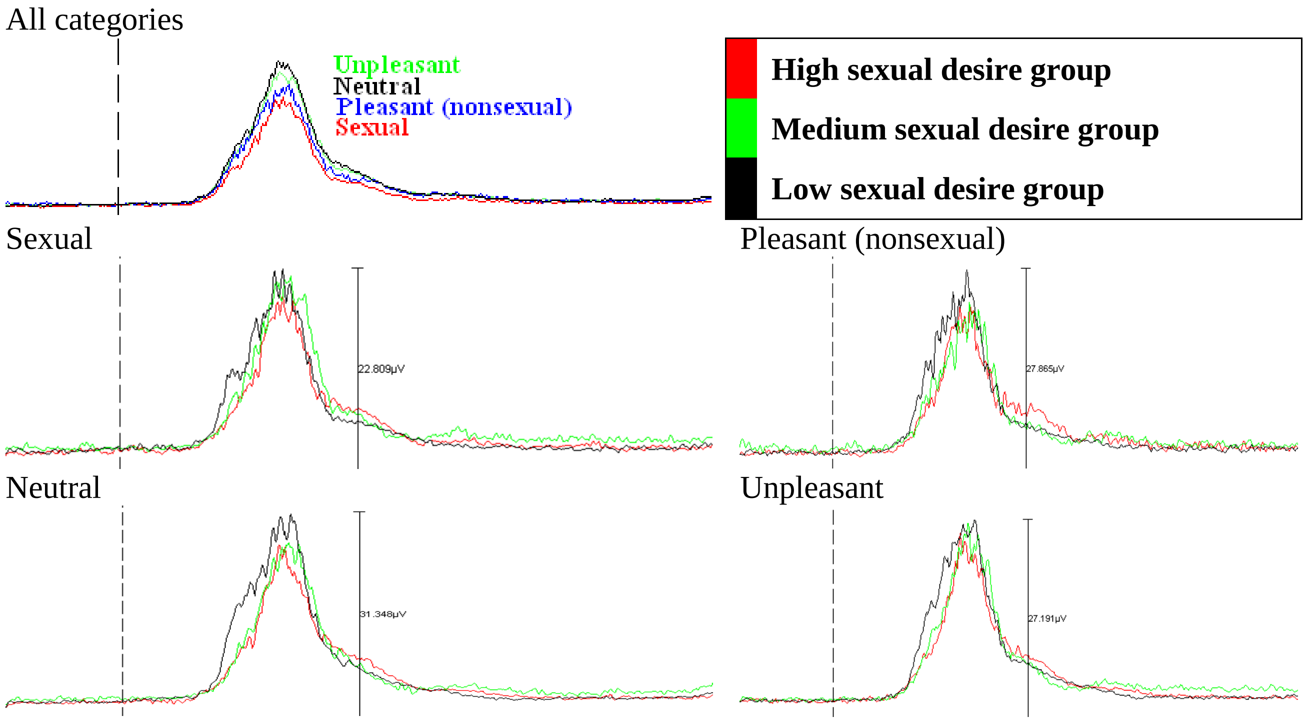

All categories
Unpleasant
Neutral
Pleasant (nonsexual)
Sexual
High sexual desire group
Medium sexual desire group
Low sexual desire group
Sexual
22.809µV
Pleasant (nonsexual)
27.865µV
Neutral
31.348µV
Unpleasant
27.191µV

Figure 7.

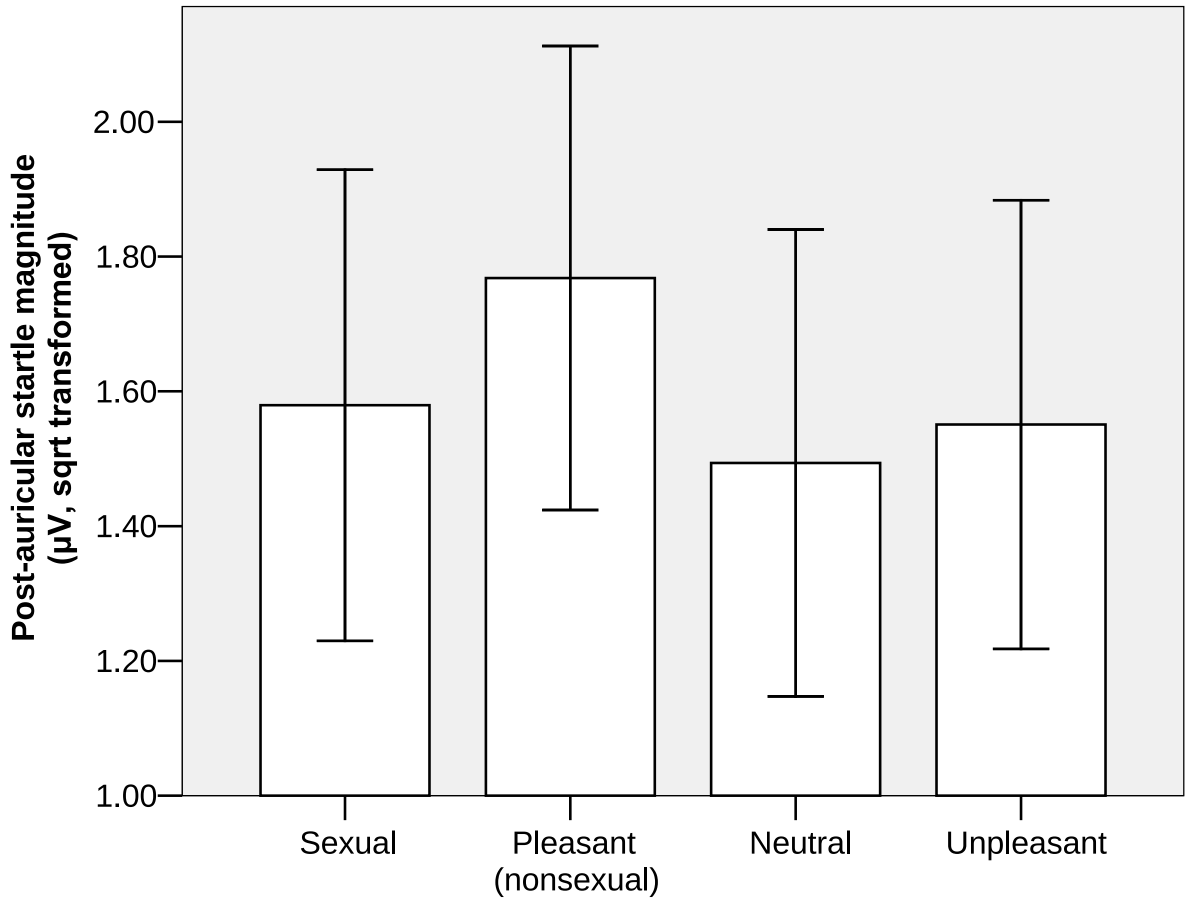
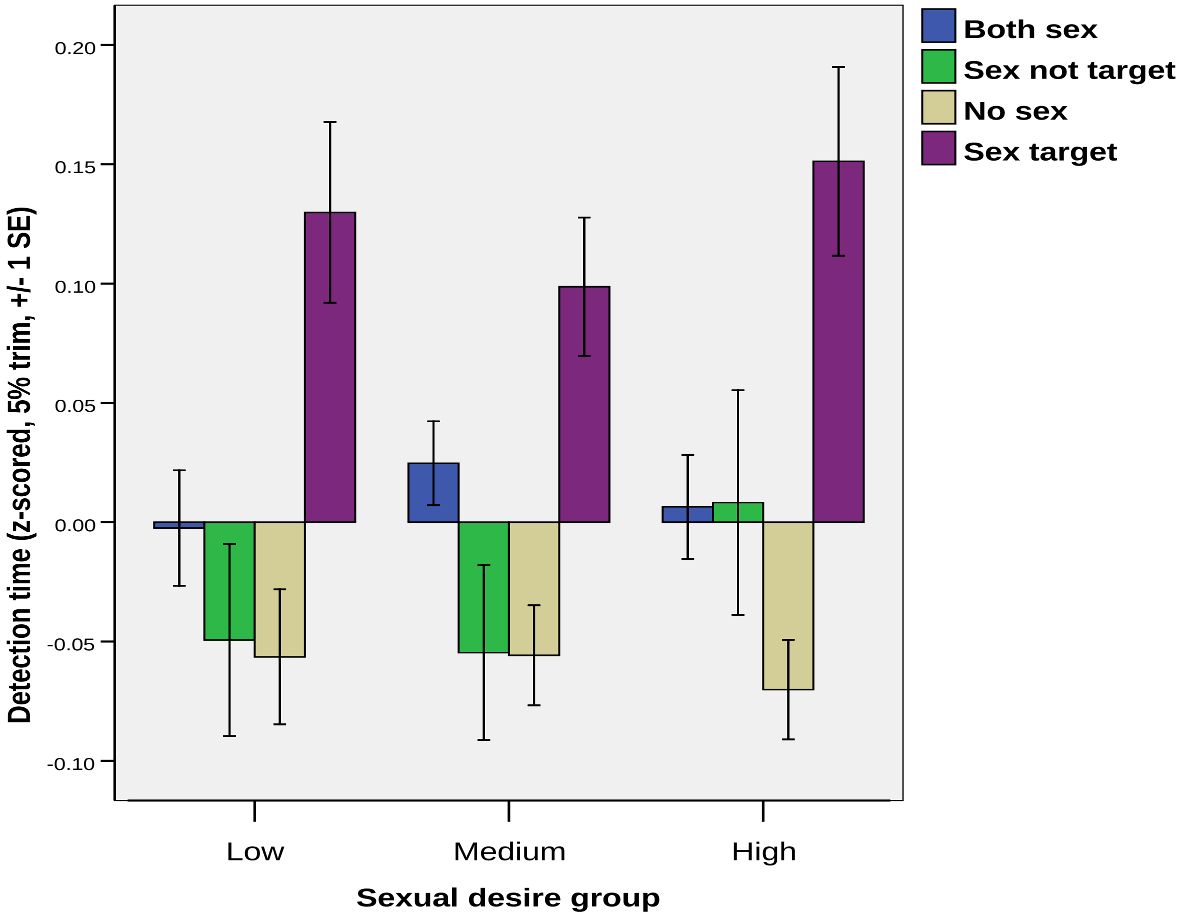
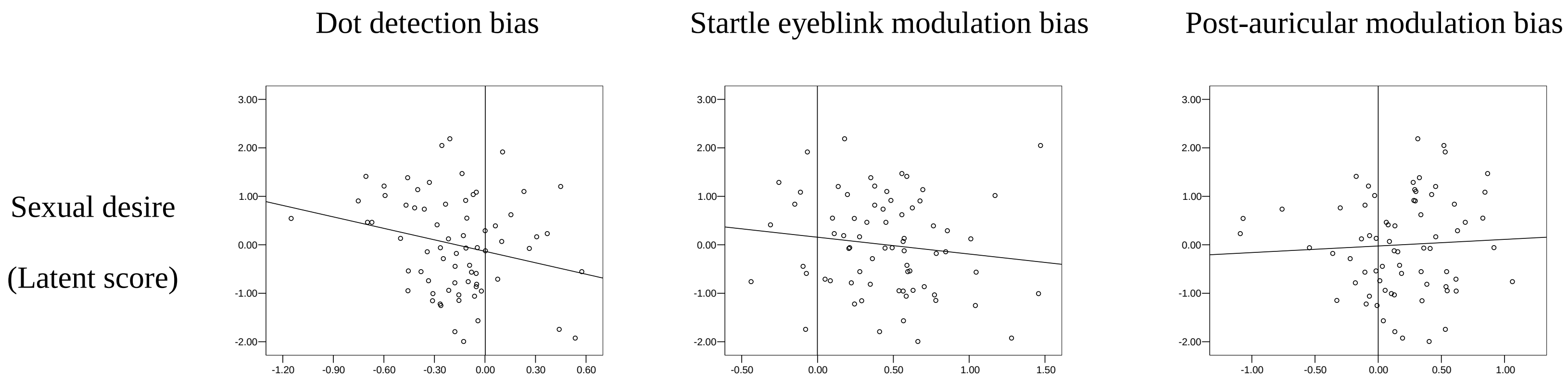

Post-auricular startle magnitude
(µV, sqrt transformed)
2.00
1.80
1.60
1.40
1.20
1.00
Sexual
Pleasant
(nonsexual)
Neutral
Unpleasant

Figure 8.



Both sex
Sex not target
No sex
Sex target
0.20
0.15
0.10
0.05
0.00
-0.05
-0.10
Detection time (z-scored, 5% trim, +/- 1 SE)
Low
Medium
High
Sexual desire group

Figure 9.

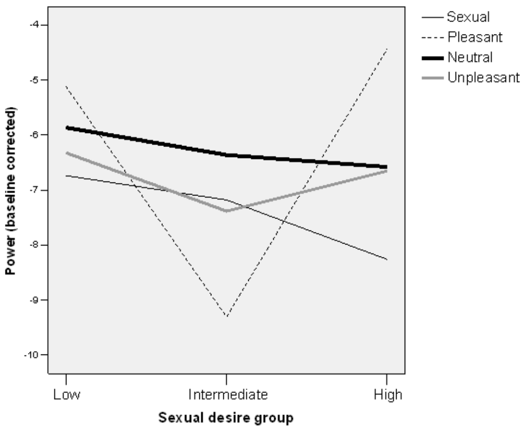


Dot detection bias
Startle eyeblink modulation bias
Post-auricular modulation bias
Sexual desire
(Latent score)
3.00
2.00
1.00
0.00
-1.00
-2.00
-1.20
-0.90
-0.60
-0.30
0.00
0.30
0.60
-0.50
0.00
0.50
1.00
1.50
-1.00
-0.50
0.00
0.50
1.00

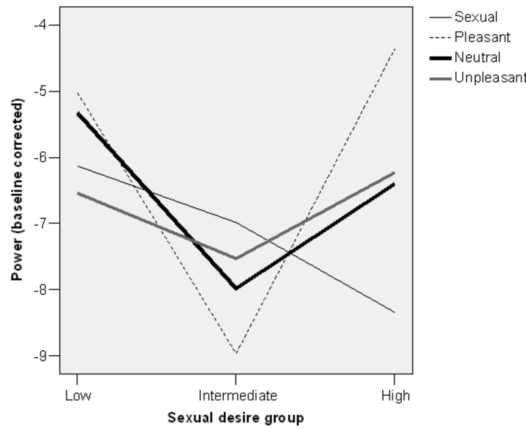
Figure 10.

Theta

Pz

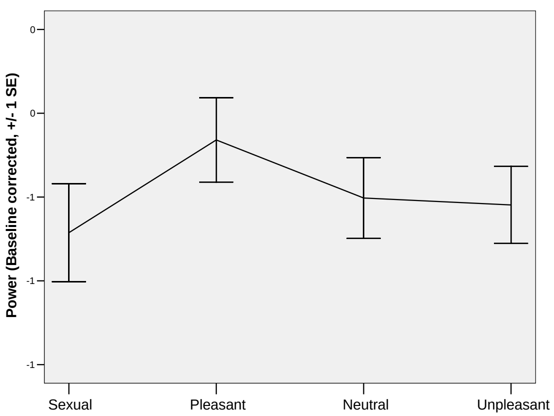


POz

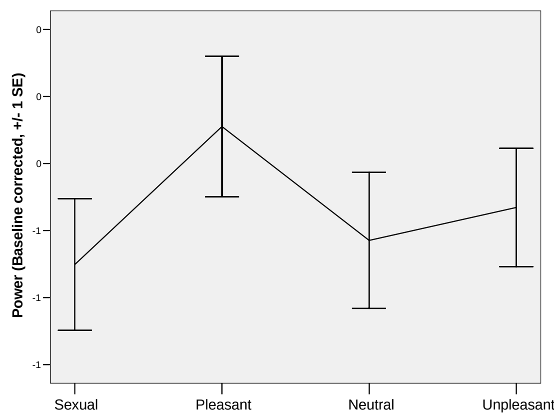


Beta

Pz



POz



Oz

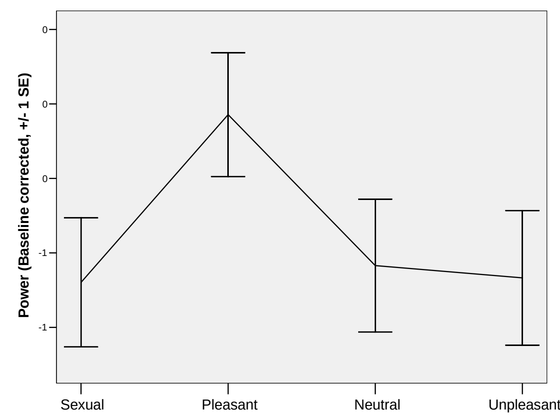


Figure 11.

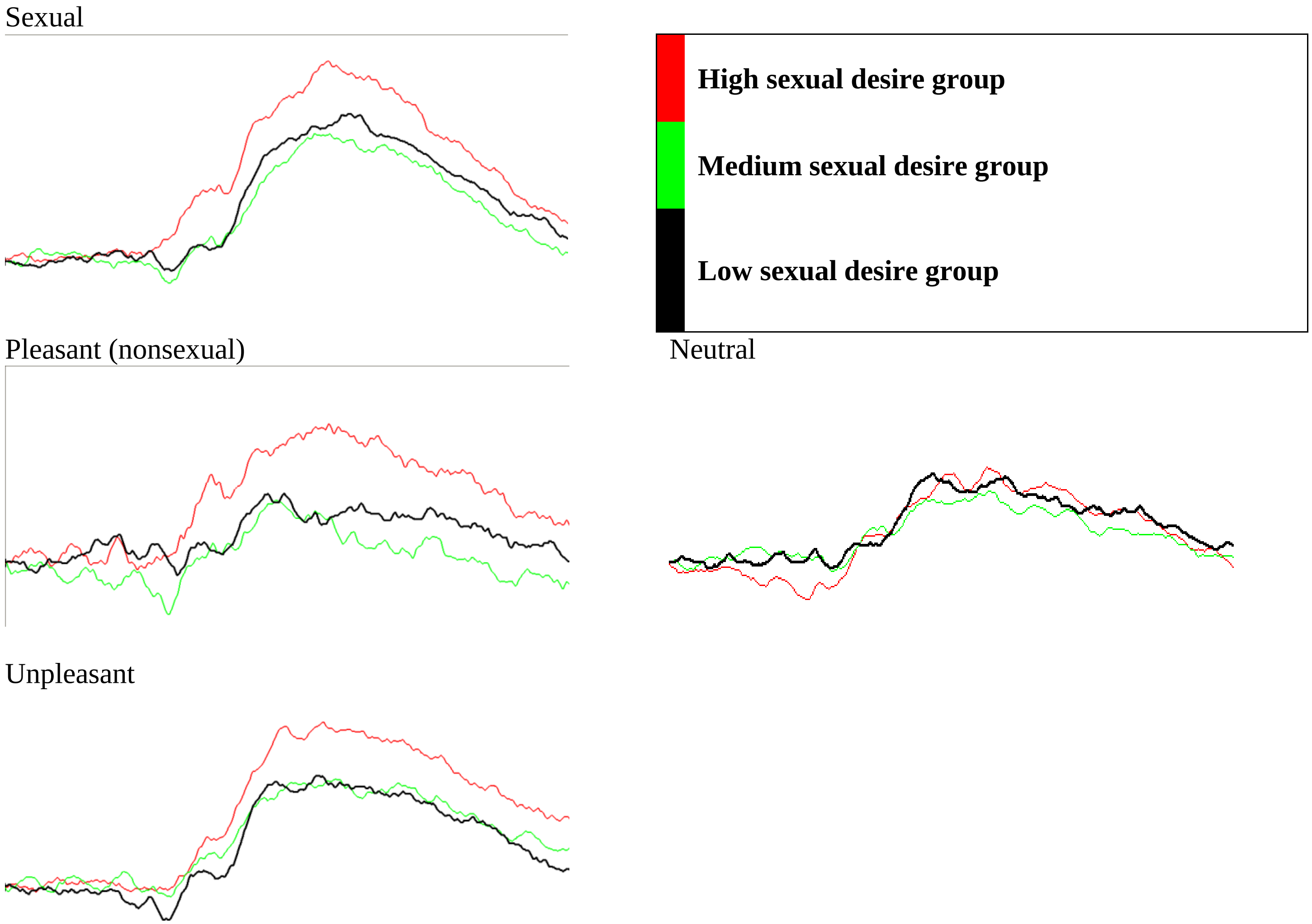
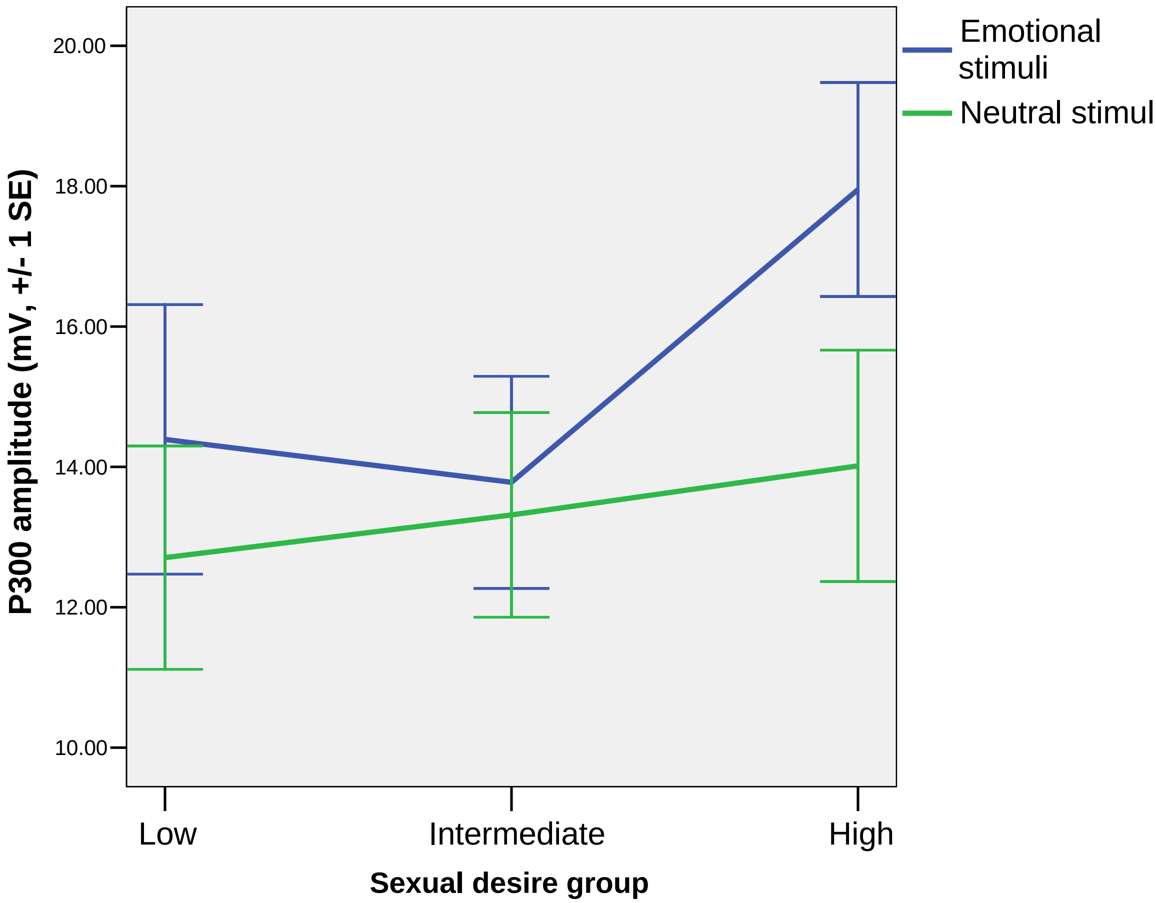

Sexual
High sexual desire group
Medium sexual desire group
Low sexual desire group
Pleasant (nonsexual)
Neutral
Unpleasant

Figure 12.


20.00
18.00
16.00
14.00
12.00
10.00
P300 amplitude (mV, +/- 1 SE)
Low
Intermediate
High
Sexual desire group
Emotional stimuli
Neutral stimuli

Appendix A.

Announcing the
Final Examination of
Nicole Prause
for the
Degree of Doctor of Philosophy in Psychological and Brain Sciences
(18^{th} of August, 11 a.m.)
128, Psychology

Little is known about why individuals vary in their levels of sexual desire. Information processing models, like Barlow's model of sexual functioning, suggest that individuals with higher sexual desire attend more and respond with more pleasant emotions to sexual cues than individuals with lower levels of sexual desire. In this study, 66 participants (33 female) completed a dot detection task, viewing time measure, and evoked response potential (ERP) measures of attention captured by sexual stimuli, and they completed startle eyeblink modulation, retrahens auriculum modulation, stimulus ratings, and electroencephalography power band measures indexing the valence of emotional response to affective stimuli. Participants with high levels of sexual desire were slower to detect targets in the dot detection task that replaced sexual pictures and in the presence of any sexual stimuli and also evinced higher ERP responses to all emotional stimuli. However, sexual desire groups did not differ in their psychophysiological measures of affective modulation nor in their ratings of sexual stimuli. The results suggest that the amount of attention captured by sexual stimuli is a stronger predictor of a person's sexual desire level than the valence of the emotional responses elicited by such stimuli.

<u>Outline of Current Studies</u>

Major: Clinical Science
Minor(s): Neuroscience
Statistics

<u>Educational Career</u>

BA, Indiana University-Bloomington, 2000

Committee in Charge

Associate Professor, William P. Hetrick (812-855-2620), Psychological and Brain Sciences

Professor, David H. Barlow (617-353-9610), Psychiatry, Boston University

Professor, Julia Heiman (812-855-7686), Psychological and Brain Sciences and The Kinsey Institute for Research in Sex, Gender, and Reproduction

Approved: ______________________________
William P. Hetrick, PhD

Appendix B.

Stimulus set for startle and electroencephalography measures

Block	Probe time	Pic type	Number of slides
1	3	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
	4	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
	5	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
2	3	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
	4	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
	5	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
3	3	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
	4	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
	5	Sexual, Lang	1
		Sexual, Spiering	1
		Pleasant	1
		Neutral	3
		Unpleasant	3
TOTAL Sexual (Without Spiering)			18 (9)
TOTAL Pleasant nonsexual			9
TOTAL Neutral			27
TOTAL Unpleasant			27
TOTAL			81
TOTAL without Spiering			72
TOTAL unprobed			18 (22%)

Appendix C.

Post-Experimental Interview

I. Clarify questionnaire responses
    a. Medications (include non-prescribed use)
    b. Physical illness (include STIs)
    c. Mental Illness
II. Erotic pictures
    a. How do you feel about erotic pictures in general?
    b. What did you think of the erotic pictures used in this study?
    c. You might have noticed that there were 2 kinds of sexual pictures. One kind was much more explicit than the other kind (e.g., one clearly showed intercourse occurring while the other tended to show kissing or other affection). Did your feelings about these 2 types differ, or would you say about the same thing about both of them?
III. Sometimes people use "strategies" in tasks that researchers don't think of. For instance, maybe you always looked to the left first when you looked for the dot on that task.
    a. Did you use any strategies for the task locating the dot quickly?
    b. Did you use any strategies while you were watching the slide show in the small room?
    c. Did you use any strategies when you were rating the pictures?
IV. Although we try to be clear, sometimes we are not as clear as we could be about what you were supposed to be doing. Was there any time when you felt like you might be doing something wrong or where you didn't understand what you were supposed to be doing?

Appendix D.

Rating Instructions

Valence

First, you will rate the picture shown as to how
pleasant or unpleasant it was.

Choose 1 if the picture was very unpleasant.
'1' would indicate that the picture made you
feel unhappy, annoyed, unsatisfied, melancholic,
despaired, or bored.

Choose 9 if the picture was very pleasant. '9'
would indicate that the picture made you feel
happy, pleased, satisfied, contented, or hopeful.

Arousing

Second, you will rate how arousing the picture was.

Choose 1 if the picture was not at all arousing. '1' would
indicate that the picture made you feel relaxed, calm, sluggish,
dull, sleepy, or unaroused.

Choose 9 if the picture was extremely arousing. '9' would indicate
that the picture made you feel stimulated, excited, frenzied,
jittery, wide-awake, or aroused.

Sexually arousing

Finally, you will rate how SEXUALLY arousing
the picture was.

Choose 1 if the picture was not at all SEXUALLY
arousing. '1' would indicate that the picture
made you feel relaxed, sexually turned-off,
or sexually unaroused.

Choose 9 if the picture was extremely
SEXUALLY arousing. '9' would indicate
that the picture made you feel sexually
stimulated, sexually excited, sexually
aroused, or horny.

Footnotes

[1] However, in neither study was sexual orientation assessed clearly. Also, no non-heterosexual groups served as controls, which may have clarified their results.

[2] Correspondingly, in this study higher Sexual Desire scores were positively correlated with pleasantness (r = .59) and sexual arousal (r = .46) ratings of the sexual stimuli.

[3] **IAPS stimuli probed:**

Pleasant-nonsexual: 2050, 2216, 2340, 8185, 8380, 8496

Pleasant-less explicit sexual: 4608, 4652, 4659, 4660, 4664, 4687, 4670, 4800

Neutral: 2020, 2200, 2214, 2221, 2381, 2441, 2493, 2580, 2595, 2690, 2745.1, 2780, 2890, 3550.2, 6570.2, 7620, 8160, 8211, 8475, 9472, 9582,

Unpleasant: 2053, 2141, 2205, 2730, 2900, 3000, 3080, 3100, 3170, 3220, 3230, 3261, 3301, 3350, 3530, 9040, 9050, 9220, 9421, 9433, 9520

Spiering, Everaerd, Elizinga (2000) stimuli probed:

Pleasant-more explicit sexual: so03, so07, so09, so10, s127, s128, s130

[4] The EEG data were downsampled for FFT analyses. The high sampling rate ensures that the bands of interest were estimated well as they are far below the Nyquist frequency of even 1024 Hz sampling.

[5] Due to the longer sample for the sustained processing window (1000 ms cp. 2000 ms) the resolution for that window was .5 Hz.

[6] I also investigated the Gratton, Coles, and Donchin (1983) and component-based correction methods. Although some have suggested that component-based methods might be feasible with few channels (Wallstrom, Kass, Miller, Cohn, Fox, 2004), PCA and ICA procedures did not appear to correct these data well. The Gratton, Coles, and Donchin method appeared to perform only marginally better than the Semlitch et al. method, and did not outperform that algorithm for the large abnormalities in VEOG artifacts. This observation is supported by the direct comparison of these measures by Croft, Chandler, Barry, Cooper, and Clarke (2005).

[7] The startle data were analyzed as raw scores, z-scored within participant, and z-scored within participant followed by a 5% trim with no change in the pattern of results.

[8] Analyses were conducted with participants divided (based on Sexual Desire score) into 2 groups, 3 groups, and 2 extreme groups from the outer third of scores. Results of analyses did not change substantively based on the group division, so 3 groups were chosen as showing results in the greatest detail.

[9] The pattern of results did not change if the average ratings of the sexual stimuli were used instead of the difference scores.

[10] Correlations also were examined to explore whether this approach, which does not partial out the individual effects of each rating to the exclusion of others as the regression does, produced different results. The correlation of Sexual desire level with ratings of pleasantness (.12), arousing (-.10), disgust (-.15), fear (.01), sexual arousal (-.12), and happiness (.11) produced similarly nonsignificant results.

[11] When gender is included in the ANOVA this effect is qualified by an interaction of Slide Type X Gender (F(3,186) = 3.48, p = .02, η_p^2 = .05). Contrasts indicated that there was a greater difference between the startle eyeblink magnitude to sexual and pleasant nonsexual stimuli in men and compared to women (F(1,62) = 6.61, p < .05, η_p^2 = .09) with women showing higher magnitude startle to pleasant stimuli.

[12] The bias score was also calculated as the difference between sexual and neutral response amplitudes. This method of calculating a bias score did not change the reported finding (e.g., sexual and pleasant difference scores)

[13] In addition to performing the analyses with previously excluded participants, analyses were also conducted including only those whose average PAR response exceeded .5 mV and 1 mV for the pleasant, neutral, and unpleasant category. None of these iterations was significant, although the pattern of differences persisted.

[14] Analyses for EEG bands also were conducted with a sample including all participants and a sample excluding only the 12 participants excluded in other analyses. One finding differed using these other samples. There was a marginal effect of stimulus type at Pz for the alpha band when all participants were used in the sample (F(3,213) = 2.76, p = .059, η_p^2 = .04) such that the sexual stimuli induced significantly less alpha band activity as compared to the pleasant nonsexual (F(1,71) = 4.25, p = .043, η_p^2 = .06), neutral (F(1,71) = 5.91, p = .018, η_p^2 = .08) and unpleasant (F(1,71) = 4.55, p = .036, η_p^2 = .06) stimuli.

[15] One question also concerned viewing non-internet pornography, but no participants reported that they currently regularly viewed non-internet erotica.

[16] In the figures it appears that the high sexual desire participants also exhibit higher P300 amplitude as compared to the low sexual desire participants. Indeed, if uncorrected post-hoc comparisons (e.g., LSD) are used a significant difference emerges, but the difference appears too weak to warrant further comment.

CURRICULUM VITAE

Nicole Prause

Work Address: Department of Veterans Affairs Medical Center
150 S Huntington St.
Jamaica Plain, MA 02130-4820

Office Phone: (857) 203-6444

Email: nprause@indiana.edu

EDUCATION

PhD 2007 (expected) Indiana University, Bloomington (APA approved)
Dept Psychological and Brain Sciences
Major: Clinical Science
Minors: Statistics, Neuroscience
Dissertation: *The role of attention and emotion in variations of sexual desire*
Successfully defended August, 2006
Committee Chair: William Hetrick, PhD
Committee member: David Barlow, PhD
Committee member: Julia Heiman, PhD

BA 2000 Indiana University, Bloomington
Majors: Psychology and Sociology
Advisor: Richard McFall, PhD

1997 Trinity University, San Antonio, Texas
Major: Sociology

RESEARCH EXPERIENCE

2005-present **Predoctoral Research Fellow**
Sexual Studies Laboratory
Duties:
1. Conducted methodological investigation comparing measures of genital arousal in women and convergence with measures of attention allocation (role of distraction).
2. Selected, ordered, and set-up psychophysiological equipment for the laboratory.
3. Interact with participants in sensitive testing paradigm, including placement and monitoring of genital measurement devices.
4. Trained research assistants in psychophysiological measures (labial thermistor, vaginal photoplethysmography) data processing (running VB, tcl, and SPSS scripts that I wrote).

Supervisor: Julia Heiman, Ph.D.

Skills: Data analyses using MatLab, data processing using VB and tcl scripts and MacroRecorder, circuitry for psychophysiological systems (e.g., ttl communication), data presentation using MediaLab, ACQKnowledge presentation/analysis software, use of Final Cut Pro for stimulus generation; completed training for ActionScripting in Flash for online data acquisition

2004-present **Predoctoral Research Fellow**

Psychopathology and Neuropsychometry Laboratory

Duties:

1. Conducted electroencephalographic studies of motivational and emotional stimulus processing in health using visual evoke response potential paradigms; conducted studies of new methods for measuring emotional modulation through novel startle paradigms (retrahens auriculum).
2. Awarded Ford Foundation support for dissertation work to investigate the role of the attention in variability in sexual motivation as contributing to disorders of desire (e.g., hypoactive sexual desire, sexually compulsive behaviors).
3. Trained research assistants in psychophysiological measures (EEG, EMG for orbicularis oculi and retrahens auriculum) and analyses (NeuroScan and MatLab scripts that I wrote).

Supervisor: William Hetrick, Ph.D.
Julia Heiman, Ph.D.

Skills: Audiometer stimulus verification, and software for stimulus generation (GoldWave) and presentation (STIM, Presentation, and limited eprime) and data processing (Neuroscan, exposure to ICA for ERP)

2002-2004 **Predoctoral Research Fellow**

The Kinsey Institute for Research Psychophysiological Laboratory

Duties:

1. Conducted psychophysiological studies of information processing models of emotion and motivation using vaginal and labial photoplethysmography.
2. Train undergraduate research assistants and conduct laboratory course.

Supervisor: William Hetrick, Ph.D.
Julia Heiman, Ph.D.

Skills: Use and analysis of photoplethymography, cardiovascular, and respiration measures.

2000-2002 **Graduate Research Assistant**

Biobehavioral Alcohol Research Laboratory

Duties:

1. Conducted two studies of (1) sexual decision making under the influence of alcohol using direct administration, cognitive modeling, and psychophysiological methods and (2) personality models of sexual risk propensity
2. Assisted in ERP processing (peak picking using ACQKnowledge software) for others' laboratory projects.
3. Awarded Society for the Scientific Study of Sexuality research grant and The Kinsey Institute Grant-in-Aid in competitive applications.

Supervisor: Peter Finn, Ph.D.

Skills: Use and analysis of the Rigiscan (penile response), vaginal photoplethysmograph, and breathalyzer; calculation, monitoring, and administration of alcohol; work with C+ programmed presentation software; analyses using SAS; Structural equation modeling using Lisrel and AMOS.

CONSULTANTSHIPS

Research psychologist consulted for pharmaceutical trial design and analysis for Eli Lilly, Indianapolis, IN, November 2001-June 2002.

Psychophysiology analyst for Discovery Channel Canada, Bloomington, IN, July 2004.

HONORS

2007 Society for Sex Therapy and Research, Student Research Award
2001 Kinsey Institute Summer Training Program acceptance
2000 BA, Summa cum laude
2000 Departmental honors, Department of Psychology
2000 Senior Achievement Award, Department of Psychology
2000 Senior Achievement Award, Department of Sociology
2000 Excellence in Research Award, Department of Psychology
2000 Psi Chi Award for Outstanding Service

TEACHING EXPERIENCE

2007 Invited lecture
Veterans Affairs Medical Center, West Roxbury, MA
Course title: Grand Rounds
Lecture title: Psychologic treatment of sexual dysfunction and spinal cord injury
Recipients: Multi-disciplinary (Physician, residents, psychologists, social work)

2006 Invited lecture
Veterans Affairs Medical Center, Jamaica Plain, MA
Course title: Boston Consortium Didactic Series
Lecture title: Grants for psychologists: Federal and private
Recipients: Psychology interns

2001-2006 Instructor
The Kinsey Institute for Research in Sex, Gender, and Reproduction
Course title: Readings and Research in Psychology
Recipients: Advanced undergraduates

2005 Invited lecture
Indiana University, Bloomington
Course title: Marital and family violence
Lecture title: Sexual dysfunction in couples

Recipients: Advanced undergraduates

2004 Instructor
Indiana University, Bloomington
Course title: Research Methods
Recipients: Undergraduates

2003 Instructor
Indiana University Continuing Studies, Bloomington
Course title: Personality Psychology
Recipients: Undergraduates

1998 Section Instructor
Indiana University, Bloomington
Course title: Introduction to Human Sexuality
Recipients: Undergraduates

1998 Undergraduate Teaching Assistant
Indiana University, Bloomington
Course title: Constructing Human Sexuality
Recipients: Undergraduates

EDITORIAL EXPERIENCE

2005 Ad hoc reviewer for *Archives of Sexual Behavior*
2006 Ad hoc reviewer for *Psychophysiology*
2007 Ad hoc reviewer for *Sexuality and Disability*

MEMBERSHIP

International Academy of Sex Research, Elected affiliate member
Association for Psychological Science, Student Affiliate
Society for Psychophysiological Research, Student Affiliate
Association for Behavioral and Cognitive Therapies, Student Affiliate
Society for the Scientific Study of Sexuality, Student Affiliate

GRANT AND FELLOWSHIP SUPPORT

"The role of emotion, attention, and couple differences in sexual desire". *Principle investigator* for Social Science Research Council fellowship supported by the Ford Foundation *Direct costs*: $28,000.

"Research Training in Clinical Science". *Clinical science trainee* for an NIMH T-32 intramurally-competitive award. *Direct costs (program, year):* $174,000.

“Identity, Self, Role, and Mental Health”. *Fellow* for an NIMH T-32 intramurally-competitive award. *Direct cost (2 years, individual fellow): $*52,824.

“Information processing models of sexual desire modulation”. *Principle investigator* for President’s Summer Undergraduate Research Initiative awarded through Indiana University *Direct costs*: $4,934.

“Information processing models of sexual desire modulation”. *Principle investigator* for The Kinsey Institute Student Grant-in-Aid. *Direct costs:* $500.

“The role of acute ethanol consumption on sexual arousal and sexual risk taking”. *Principle investigator* for The Kinsey Institute Student Grant-in-Aid. *Direct costs:* $500.

“The role of acute ethanol consumption on sexual arousal and sexual risk taking”. *Principle investigator* for the Indiana University Women in Science Program Travel Grant to present at the International Academy of Sex Research, *Direct costs:* $800.

“The role of acute ethanol consumption on sexual arousal and sexual risk taking”. *Principle investigator* for the Society for the Scientific Study of Sexuality Student Research Grant, *Direct costs:* $1000.

“Asexuality identity”. *Principle investigator* for the Safer Sexuality Outreach Program of Bloomington Indiana Research Grant, *Direct costs*: $500.

“Creating ecologically-valid, computerized emotional expression stimuli”. *Research trainee* for the Indiana University President’s Summer Undergraduate Research Initiative, *Direct costs:* $500.

PUBLICATIONS

Prause, N., Janssen, E., & Hetrick W. P. (2006). Attention and emotional responses to sexual stimuli and their relationship to sexual desire, *Archives of Sexual Behavior*, manuscript in press.

Prause, N. & Graham, C. (2006). Asexuality: Predictors and description. *Archives of Sexual Behavior,* manuscript in press.

Prause, N., Cerny, J., & Janssen, E. (2005). Labial Plethysmograph: A new measure of female genital arousal. *Journal of Sexual Medicine,* 2(1), 58-65.

Prause, N., & Janssen, E. (2005). Blood flow: Vaginal photoplethysmography. In I. Goldstein, C. M. Meston, S. Davis & A. Traish (Eds.), *Textbook of Female Sexual Dysfunction*. London: Taylor & Francis Medical Books.

Janssen, E., Geer, J., & Prause, N. (2005). The sexual response system. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), Handbook of Psychophysiology (3rd edition). New York: Cambridge University Press.

Ames, K., Prause, N., Stout, K., & Hetrick, W. P. (2003). Differential effects of affective modulation on orbicularis and post-auricular indices of startle. *Psychophysiology, 40* (Supp 1), S22.

Prause, N., Janssen, E., & Hetrick, W. P. (2003). The role of attention and affective response to sexual cues in the experience of sexual desire and sexual arousal. *Psychophysiology, 40* (Supp 1), S69.

Prause, Nicole. (2002). BOOK REVIEW: Celibacy, Culture, and Society: The anthropology of sexual abstinence. *Archives of Sexual Behavior*, 31, 84-86.

Spencer-Smith, J., Wild, H., Innes-Ker, Å., Townsend, J. T., Duffy, C., Edwards, C., Ervin, K., Prause, N., & Paik, J. W. (2000). Making faces: Creating 3-dimensional, ecologically-motivated poseable expressions. *Behavior Research Methods, Instruments and Computers,* 33, 115-123.

MANUSCIPTS SUBMITTED AND IN PREPARATION

Prause, N., & Hetrick, W. (2006). Affective modulation of the post-auricular muscle response: An appetitive index, manuscript submitted for publication.

Prause, N., Janssen, E., & Finn, P. (2006). The role of acute ethanol consumption in sexual arousal and sexual risk taking, manuscript in preparation.

Prause, N. & O'Farrell, T. J. (2006). Sexual functioning changes over time in alcoholic males in treatment and their female partners, manuscript in preparation.

Prause, N. & Heiman, J. (2006). Assessing female sexual arousal with the labial thermistor: Response specificity and construct validity, manuscript in preparation.

PRESENTATIONS

Prause, N., Janssen, E. & Hetrick, William P. (2007, March). Attention modulation to sexual stimuli and their relationship to sexual responsivity. Invited paper for the annual meeting of the Society for Sex Therapy and Research, Atlanta, Georgia.

Prause, N. & Heiman, J. (2006, July). Response specificity and construct validity of the labial thermistor as compared with the vaginal photoplethysmograph. Poster session presented

at the annual meeting of the International Academy of Sex Research, Amsterdam, Netherlands.

Prause, N., Janssen, E., & Hetrick, William P. (2006, July). Attention and emotional responses to sexual stimuli and their relationship to sexual desire. Poster session presented at the annual meeting of the International Academy of Sex Research, Amsterdam, Netherlands.

Librach, Giliah R., Harris, Julianna, & Prause, Nicole R. (2006, May). Transfer of orgasm consistency to partner setting moderated by sexual desire. Poster session presented at the annual meeting of the Association for Psychological Science, New York, NY.

Prause, N. (2005, June). Labial photoplethysmography. Paper for the annual meeting of the World Congress of Sexology, Montreal, Canada.

Janssen, E., Prause, N., & Hahn, S. (2004, November). Mood, sexual arousal, and sexual risk taking. In Mustanski, B. (Symposium chair), Mood and Sexuality. Paper presented at the Society for the Scientific Study of Sexuality, Orlando, Florida.

Prause, N., Janssen, E., & Hetrick, W. (2004, November). The role of emotion and attention in variations in sexual desire. In Mustanski, B. (Symposium chair), Mood and Sexuality. Paper presented at the annual conference of the Society for the Scientific Study of Sexuality, Orlando, Florida.

Prause, N. (2004, October). The role of emotion and attention in variations in sexual desire. Paper presented at the annual meeting of the Social Science Research Council, Bloomington, IN.

Prause, N. & Janssen, E. (2004, June). Four approaches to the processing of vaginal pulse amplitude (VPA) signals. Poster session presented at the annual meeting of the International Academy of Sexuality Research, Helsinki, FI.

Prause, N. (2004, May). Determining sexual desire. Paper presented at the Kinsey Institute Interdisciplinary Seminar Series, Bloomington, IN.

Prause, N. (2003, November). Don’t get it, don’t want it, don’t care: Constructing Asexuality. Paper presented at the Gay, Lesbian, Bisexual, Transsexual organization, Bloomington, IN.

Prause, Nicole & Graham, C. A. (2003, November). Asexuality: A preliminary investigation. Poster session presented at the annual meeting of the Society for the Scientific Study of Sexuality, San Antonio, TX.

Ames, K., Prause, N., Stout, K., & Hetrick, W. P. (2003, November). Differential effects of affective modulation on orbicularis and post-auricular indices of startle. Poster session

presented at the annual meeting of the Society for Psychophysiological Research, Chicago, Illinois.

Prause, N., Janssen, E., & Hetrick, W. (2003, November). The role of attention and affective response to sexual cues in the experience of sexual desire and sexual arousal Poster session presented at the annual meeting of the Society for Psychophysiological Research, Chicago, Illinois.

Prause, N., Janssen, E., & Hetrick, W. (2003, July). The effects of early processing of sexual cues on subsequent sexual functioning: A pilot study. Poster session presented at the annual meeting of the International Academy of Sex Research, Bloomington, Indiana.

Prause, N., Janssen, E., Cohen, J., & Finn, P. (2002, June). Effects of acute ethanol consumption on sexual arousal and sexual risk taking. Poster session presented at the annual meeting of the International Academy of Sex Research, Hamburg, Germany.

Prause, N. (2002, May). Effects of acute ethanol consumption on sexual arousal and sexual risk taking. Paper presented at the National Institutes of Mental Health Program in Identity, Self, Role, and Mental Health, Department of Sociology, Bloomington, IN.

Prause, N. & Finn, P. (2002, June). No modulation of sexual risk taking and excitement seeking relationship by cognitive capacity. Poster session presented at the annual meeting of the American Psychological Society, New Orleans, LA, United States.

Prause, N., Weinberg, M., & Graham, C. A. (2002, March). Rethinking low sexual desire: The desire construct and asexuality. Paper presented at the Clinical Colloquium series of the Indiana University Department of Psychology in Bloomington, Indiana, United States.

Cerny, J., Prause, N., & Janssen, E. (2001, October). A new instrument assessing genital hemodynamic changes in women. Poster session presented at the annual meeting of the Female Sexual Functioning Forum, Boston, MA.

Prause, N., Graham, C. A., & Janssen, E. (2001, June). No concordance between subjective and physiological sexual arousal in women: Different instructions, different correlations. Poster session presented at the annual meeting of the American Psychological Society, Toronto, Ontario, Canada.

Prause, N., Graham, C. A., & Janssen, E. (2001, June). Effects of different instructions on within- and between-subject correlations of physiological and subjective sexual arousal in women. Poster session presented at the annual meeting of the International Academy of Sex Research, Montreal, Canada.

COMPUTING SKILLS

MediaLab, expert
ACQKnowledge, expert
NeuroScan, user
Tcl, user
Visual Basic, user
PsyLab, user
CSS, user
Final Cut Pro, user
ActionScript, novice
MatLab, novice

REFERENCES

William P. Hetrick, PhD
Dept Psychological and Brain Sciences
Indiana University
1101 E Tenth St.
Bloomington, IN 47405

Julia Heiman, PhD
The Kinsey Institute for Research in Sex, Gender, and Reproduction
313 Morrison Hall
1165 E. Third St.
Bloomington, IN 47405

Cynthia Graham, PhD
Isis Education Centre
Warneford Hospital
Headington, Oxford OX3 7JX